AN ESSAY ON WATERS.

IN THREE PARTS.

TREATING,

I. Of SIMPLE WATERS.
II. Of COLD, MEDICATED WATERS.
III. Of NATURAL BATHS.

By C. LUCAS, M.D.

ΙΠΠΟΚΡΑΤ. Περὶ Ἀερων, Ὑδάτων, Τόπων.
Δεῖ δε καὶ τῶν ὑδάτων ἐνθυμέεσθαι τὰς δυνάμιας.

HIPPOCRAT. De Aere, Aquis et Locis. ANUT. FOESIO interprete.
Quinetiam, AQUARUM Facultates animo reputare oportet.

LONDON,
Printed for A. MILLAR, in the Strand.
MDCCLVI.

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ON

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TO

THAT MOST ILLUSTRIOUS ORNAMENT

TO THE

BRITISH STATE,

THE RIGHT HONORABLE,

The EARL of MACCLESFIELD,

PRESIDENT,

AND

The RIGHT HONORABLE, HONORABLE and

MOST RESPECTABLE,

The COUNCIL and FELLOWS

OF THE

ROYAL SOCIETY;

THESE TRACTS

ARE OFFERED AND SUBMITTED,

AS A PUBLIC TESTIMONY

OF THE MOST PROFOUND RESPECT

AND VENERATION

OF THE

AUTHOR.

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TO
HIS ROYAL HIGHNESS
THE
PRINCE.

WHILE the admiring multitude of the fair and great, preſs with eager deſire to attend upon YOUR ROYAL perſon; an humble ſtranger at Your court begs to approach, and preſent a public teſtimony of his affection and duty to the Heir Apparent of the thrones of theſe kingdoms; in dedicating to YOUR ROYAL HIGHNESS, the Firſt-fruits of his phyſical labors.

I am well aware, that this, at firſt ſight, to ſome may ſeem an odd ſort of preſent to a Prince; a phyſical or medicinal Eſſay, out of the way of, or perhaps beneath, his attention.

But, if YOUR ROYAL HIGHNESS be pleaſed to reflect, that the God-like Art of preſerving or reſtoring the health of man was originally

practiſed by Heroes, Philoſophers, and Kings; that, of old, no branch of this Art was deemed too mean to be exerciſed by Prieſts, Prophets, or Princes; and that, of later date, it has been found an object worthy of the care and ſanction of the wiſeſt of Legiſlators and Potentates; the ſubject matter of this little book, however meanly it may herein be handled, can not be judged below the regard of him, who is one day to hold the reins of theſe great governments, and to be the SUPREME GUARDIAN of the natural, as well as political health of the people.

In antient times, before the rules and records of the healing art were eſtabliſhed and reduced to the juſt order, in which they now ſtand; the grateful votaries of the GOD of HEALTH poſted up in his temple, the hiſtories of their diſeaſes, and the means, by which their cures were wrought; with the juſt intent, at once, to ſet forth their own gratitude to the preſiding divinity, to teach others how to recover loſſed health, in the like caſes, and to prize it properly, when reſtored.

Without political health, life, with full enjoyment of natural health, and even with the greateſt affluence of the goods of fortune, would be very far from deſireable, in mine eſtimation. The former, in juſt preference to the later, was certainly meaned by thoſe wiſe and worthy rulers,

ers, who eſtabliſhed, as the principal axiom of their polity, SALUS POPULI SUPREMA LEX ESTO.

Every ſenſible member of our community muſt ever keep theſe things in view. Muſt love his country better than himſelf, and look upon the reſtorers and preſervers of it's polity, as the GODS of the PUBLIC HEALTH.

If your ROYAL HIGHNESS will permit me but to point out theſe, the motives of my dedication will be ſeen, and ward off the deteſtable imputation of adulatory or ſervile views upon this occaſion.

Amidſt the numberleſs violent diſtempers, that have from time to time aſſailed the ſtate; amidſt the many dreadful ſhocks and ghaſtly wounds, given the Body Politic, by weak or wicked governors, flattering, perfidious miniſters, and corrupt counſilors, the onely enemies our happy realms can fear; none more iminently threatned a fatal diſſolution, than thoſe given by that perjured race of princes, that broke THEIR COMPACT with their ſubjects, ſoon after the ſolemn renewal of it, at their coronations; and thereby, abſolved the people from their allegiance, diſſolved the political conſtitution, and left the late REVOLUTION the ſole expedi-

ent for ſaving our religious and civil liberties from utter ſubverſion.

By this alone, the diſſolved civil conſtitution, that paragon of perfect polity, like the fabulous Arabian bird, from it's own aſhes, roſe more vigorous, more reſplendent from it's awful ruins. The government was, as it was at firſt conceived and inſtituted, revived and reeſtabliſhed, by matchleſs wiſdom and virtue; on which alone, it muſt at all times depend for ſupport. The head and each member of the government was reſpectively taught his particular duty, the functions of his ſphere, and the extent and limits of his power, privilege and authority.

And thus, we once more ſaw the REGAL OFFICE reinſtituted, by the POPULAR VOICE; again adorned with all the MAJESTY of the PEOPLE, untainted with deſtructive deſpoticiſm.

To counſil and aſſiſt this firſt, this great eſtate, ARISTOCRACY, without OLIGARCHY, was joined; and to balance the firſt and ſecond, DEMOCRACY, without ANARCHY, was reſtored.

Thus, the POLITICAL CONSTITUTION was renewed; having all the excellencies of the beſt forms of civil government, without any of their

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evils, united in the three estates of KING, LORDS, and COMMONS, that constitute our GLORIOUS COMMONWEALTH; and their respective powers and privileges ascertained and blended, in such equal, such attemperating proportions, as strengthens, balances and secures the whole, and leaves none of the constituent parts, not even the inferior limbs of our body politic, room to repine at his lot; since, the meanest is as free in his low, as the greatest in his exalted, sphere; and the last, as well as the first, gives his consent, in his proper person, or by his representative, to the system of laws, by which he is at once governed and protected.

Who can reflect on this, and not exult at being born a BRITON?—Who can enjoy these matchless, these invaluable blessings, without remembering, with a thankful heart, the SOURCES, whence they were drawn? Who can be so ungrateful, so insensible, as to overlook or forget THOSE, by whom they are now maintained, and promised to be perpetuated?

I should judge myself unworthy of these unparalleled benefits, could any means be able to efface the grateful sense of them, imprinted on mine heart. The justest of our politicians judge, that PROTECTION and ALLEGIANCE are obligations, mutual and reciprocal, between the Governor and Governed; and that, when the

one is withdrawn, the other ceaſes to be a debt.

Yet, pardon mine ambition, to let YOUR ROYAL HIGHNESS ſee my ſentiments of loyalty and gratitude upon this occaſion; though I am, I hope, the Onely living ſubject, that can of a truth complain of having been denied the potection, that even criminals enjoy from our laws; having notoriouſly ſuffered the Oppreſſor's Wrongs, the Laws Delay, and the Inſolence of Office, to ſay no more; and that, without any taſte or proſpect of redreſs; Notwithſtanding, I can call upon my bittereſt enemies to atteſt, that it has not been in the power of perſecution and adverſity to pervert my ſenſes, ſo far as to make me impute the unauthoriſed outrages of Subſtitutes to the PRINCIPAL, or make me one moment diſregard or forget the DELIVERERS of my country, the RESTORERS and PRESERVERS of our moſt valuable, our POLITICAL HEALTH.

Whatever the flatterers of tyrants might have heretofore inſinuated, it is now confeſſed in truth, that all kings are of human appointment; and that whatever might have been the caſe among the antient Jews, no nation can now boaſt any other.

Yet, in a figurative ſenſe, they may well be deemed the ANOINTED of HEAVEN, who lay

clame to the ſacred titule, by proving themſelves moſt truly HEAVEN'S VICEGERENTS. The FOUNDERS firſt, and after theſe, the RESTORERS of our great National Conſtitution, deſerve our principal veneration; and next to theſe, we ſhould ſurely bear it's PRESERVERS in our hearts.

Our Deliverance then, ROYAL SIR, had poſſibly been but momentary, had not the wiſdom of our deliverers intailed the REGAL OFFICE upon a Family, long diſtinguiſhed by Heaven as it's Vicegerents, upon the continent, in the reſtoring and protecting the true religion, and good civil policy, where both had been long overturned by ſuperſtition and tyranny; and, had not that moſt ILLUSTRIOUS, that CHOSEN FAMILY, anſwered the CALLS of THIS PEOPLE, as the VOICE OF GOD, and acceded to the thrones of theſe Redeemed Realms.

The honeſt, the truly affectionate and loyal man can never flatter YOUR ROYAL HIGHNESS. It is a vice, that deforms human nature. It is a moſt ſubtil, ſure poiſon; whoſe influence is not often perceived, before it's deadly work is performed. Few, if any men, are proofs againſt it's bane; and unhappily, princes, being generally more early inured to it, are of all men the leſt aguard againſt, though of all others, the moſt expoſed to, it's dire effects.

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As beneath the dignity of a free-born, undesigning man, and injurious to YOUR ROYAL HIGHNESS, as well as inconsistent with the disinterested love and duty, I bear YOU; I shall avoid all handles to the imputation of this destructive vice, the common sauce to make unsavory dedications palatable.

YOUR ROYAL HIGHNESS will therefore give me leave to declare, that it is not from any hopes or fears, I feel; from any degree of that servile reverence, that slaves pay their sovereigns; from any propensity to repose implicit or boundless confidence in princes; from any tendency to passive obedience, and much less is it from any regard to the ridiculous absurdity of an Indefeasable Hereditary Right to Tyrannise; that I pay my devotion to the ROYAL FAMILY, that now does honor to the British throne, or thus address myself to the HOPEFUL HEIR APPARENT of the crowns of our kingdoms.

Could I be thus mean and servile, I should in no respect be qualified to address YOUR ROYAL HIGHNESS upon this, or indeed upon any other, occasion. But, my views are very different from such as these motives prompt: A religious reverence to the laws must ever make me ready to render unto CAESAR, the things

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that are CAESAR's. But, reaſon, clear conviction, and a ſenſe of gratitude muſt carry me further, and dictate more exalted ſentiments.

Thoſe make me look back, and trembling recollect the ruin, that threatned theſe kingdoms, during the laſt years of a late regne, in ſpight to all, that was provided for us, by the REVOLUTION and the ACT OF SUCCESSION.

Auſpicious Heaven ſaw our diſtreſſes and dangers; and bad YOUR GREAT GRANDFATHER diſpel our fears. He came. He filled the throne with dignity. He fulfilled his miſſion, He anſwered the expectations of his people. He reſtored Parlements to their priſtine weight and authority; and, as he ſquared all his political conduct by their counſil, Britain again was free.— If any diſorder aroſe in the Body Politic, while he preſided over it's health; the cauſe, upon juſt enquiry, will be found among the Members; by no means in the Head.

When it pleaſed the Ruler of Princes to tranſlate this Hero to a more exalted crown; His ſon, YOUR ROYAL GRANDFATHER, ſucceded to his virtues, with his temporal throne.

To avoid the moſt remote appearances of adulation, as well as repetitions of ſentiments, I have already, to my coſt, recorded of his

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MAJESTY[a], I ſhall ſay no more of him at preſent, than pray, that he may live long to ſhare in the health, natural, religious and political, in the general happineſs, which he ſecures to his faithful people! And ever be able, juſtly to diſtinguiſh his real, from his pretended, friends!

And, though the recital muſt renew YOUR ROYAL HIGHNESS's, with the public, grief; I muſt beg leave to mention YOUR ROYAL FATHER, who eminently poſſeſſed every ſocial, every princely virtue. His death muſt have proved cauſe of endleſs affliction to the free ſubjects of theſe realms; had not bountiful Heaven provided for our future happineſs, in giving him a numerous, moſt hopeful offspring, by a PRINCESS, formed to give luſtre to the higheſt rank in life. From ſuch ſtocks, what good fruits may we not expect?

Who can take this tranſient view of the ſtate of our POLITICAL HEALTH, and not with unſpeakable gratitude and admiration obſerve, the cauſes of preſent exultation, and of future hope? Who can be at a loſs to judge, when,

[a] In the DEDICATION of my Tranſcript and Tranſlation of the Great Charter of Dublin to the King; In the COMPLAINTS of Dublin, addreſſed and preſented to the Lord Harrington, then his Lieutenant, in Ireland; In the POLITICAL CONSTITUTIONS of Great Britain and Ireland, and other loyal tracts; for which, by the matchleſs conduct of that extraordinary adminiſtration, mine election into parlement, for the Metropolis, was violently prevented, and I was, by lawleſs outrage, forced into exile.

and

and by whom, the golden axiom, before recited, SALUS POPULI SUPREMA LEX, was, is, and hereafter is likely to be, the fartheſt extended, and the moſt fully obſerved?

When then, it is conſidered, what an impreſſion this GOD-LIKE CONDUCT of governors muſt make upon ſenſible and grateful minds; upon allowing me the ſmalleſt ſhare of theſe endowments, from this curſory application, MY PRINCE will obſerve, and graciouſly indulge, the motive of this dedication; eſpecially, as YOUR ROYAL HIGHNESS may ſee, that I am not onely grateful for paſſed and preſent public, abſtracted from all views to private, benefits; but, that I go ſtill further, and comfort my country and my ſelf with the pleaſing aſſurance, that, when it ſhall ſeem good to the ſupreme Ruler of Kings to reward the care and labors of the preſent GREAT PHYSICIAN of OUR STATE, with a far nobler diadem, than that, which at preſent gives and receives a luſtre from his brow; if then, any ſhould remane ſo ſtubborn, ſo froward, or ſo ungrateful, as not to take the Remedy properly, or to acknowledge it's full benign effects; their cure and conviction muſt one day be wrought by YOUR ROYAL HIGHNESS; who ſeem to be born to diſarm and diſſolve contending factions, to recover the loſſed ſheep of our fold, to call the prodigal children home, and to unite them in ONE FAMILY,

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infolded within the arms of a tender and indulgent Parent, whom diſtant ages ſhall hail, FATHER OF HIS COUNTRY.—Theſe wiſhes, the love of my country prompts.—Theſe hopes, YOUR ROYAL HIGHNESS has raiſed.

Vouchſafe then, MOST GRACIOUS PRINCE! to permit me thus to record my grateful ſentiments in the temple of the GODS of OUR POLITICAL HEALTH; while I take the liberty of preſenting You with this ſmall tract, calculated for the ends of mine humble ſphere, to miniſter to the natural health of the ſubjects; And deign to accept of it, as a Free-will offering, and to conſider this addreſs as part of the overflowings of an heart, zealous to promote the public good, and ambitious to prove, what he has the honor of declaring, himſelf,

YOUR ROYAL HIGHNESS's

Moſt dutiful,

Moſt faithful,

And

Moſt devoted,

Humble Servant,

C. LUCAS.

THE PREFACE.

IF any body remanes ignorant of the greatneſs and importance of the ſubject of the following ſheets; however meanly the matter may be handled, a ſlight peruſal of them can hardly fail of clearing his conceptions, in this inſtance.

It will appear ſtrange to every attentive reader, that the moſt uſeful and neceſſary part of the creation, whether oeconomically, phyſically, or medicinally conſidered, has been ſo far, and ſo long neglected, as to make it, at this day, neceſſary to compile ſo large a volume as this, to rectify men's notions in ſo intereſting a point!

This will aſſuredly appear no ſmall reproach to our profeſſion; when it is found, that however ſome of greater eminence might, in this, among other inſtances, have labored for the information of their own private judgements; yet, none of them have thought fit to impart any ſhare of their knowledge, in this particular, to the public.

It were happy for the public in general, as well as for the author of the following tracts, that ſome of the firſt claſs among us, had ſet their hands to this weighty undertaking, and reſcued the ſubject from the pens of ſuch as muſt be found leſs qualified.

But, ſince none of theſe ſeems to judge it fit to imbarque in ſuch a work; it will not, I hope, be deemed arrogant in me to offer the public ſome informations in this matter, which the ſilence of the better qualified, and the impertinent intruſions of the diſqualified, have alike rendered evidently neceſſary; eſpecially, in

this country, where waters make not onely a considerable part of the Materia medica; but where the generality are so apt to run in crowds to, and drink excessively of, all the medicated waters of these kingdoms, and even of the continent.

To such, an humble attempt to rescue this interesting subject out of the hands of the ignorant, the designing, and the deceitful; and few others have with us taken much pains in this way; can hardly be unacceptable. For these, I wrote it. To these, I now offer it; with the pure intention of discharging the duty of my sphere in life; ministering, in the most extensive manner in my power, to the health of the community.

Nothing, but a thorough persuasion of the extreme necessity, as well as utility of such an undertaking, could prompt me to engage in it; at lest, to publish it, as prematurely as this, I fear, will appear. But, my fate, if I may use the phrase, reduced me to this alternative; either to write and publish quickly, or run the risk of letting the public longer, or perhaps for ever, want the little informations, I conceived, I might give them: My time and circumstances will not permit me to write and collate carefully and deliberately: Since tyranny banished me my native country, and corruption left me no means of a restoration; I layed my self out for completing the study of physic; for which, in a ministerial branch, I had before layed some foundation. It is easier to conceive, than describe, the uninterrupted series of affliction, anxiety, care, and perplexity, that has ever since attended me.

These considered, it can hardly be expected, that this tract should appear completely, or perhaps decently, equipped for a public appearance, before severe judges. But, such as it is, it must have been given, or not all. I hope the readers, if such there be, will think, that, in this premature publication, of two evils, I have chosen the lest.

Let not the miſerable word-catcher, who lives on ſyllables; or the griping critic, who wades through maſſive volumes in ſearch of faults, regardleſs of beauties, and feeds on human errors, as ſome baſe animals, on the excrements of others; let not the vindictive multitude of wretched writers, who are impatient to make ſome repriſals for expoſing their quack-bill diſſertations upon their favorite all-healing waters; let none of theſe imagine, I mean to court their indulgence, or their favor: No; I invite them, or if they chooſe the term, I challenge them, to examine it with all the rigor, that rage can prompt; with all the juſtice, they can bring on their ſide; and in whatſoever light ſhall beſt ſuit their tempers and their intentions, point out every error, I have committed, or the preſs for me, and ſeverely ſcan every fault of mine or the printer, though naturally overlooked by the author. When they have done their worſt, if they are able to bring truths to light, they muſt coincide with mine intentions; who, however miſtaken I may be found, have nothing more in view.

It is to be hoped, this declaration will ſatisfy the multitude, that have greatly affected to depretiate mine undertaking, by threatening, if ever I publiſhed any thing, to anſwer it. Some of theſe, I am told, have long ſince got their criticiſms ready for the preſs, upon a work, of which they never ſaw a line, except ſince it was printed, and that by ſtealth. And one of theſe, a gentleman of no ſmall weight, as I am told, in point of perſon; but, with whom I never had the honor of exchanging a monoſyllable; ſome months before this publication, promiſed, or rather threatened, in the hearing of a friend of mine, "that the anſwer to my book, ſhould appear as ſoon as the book itſelf." I hope, this Critic will be as good as his word; and ſerve, if not oblige, the public, in expoſing either himſelf, or me, or both, in a true light; for, knaves and fools ſhould by all means be excluded, or cut off from, the profeſſion of phyſic.

But, this is nothing to the magazine of thunder-bolts, that are ſtored up for me at Bath: There, a ſet of learned gentlemen, for none other crime, than that of differing from them in opinion; a privilege, become proverbial in the profeſſion; have not contented themſelves with the moſt inhoſpitable ſlights of a ſtranger, in their city; but have chafed their righteous ſpirits, to a moſt tremendous, I dare not ſay unbecoming, pitch of wrath and indignation againſt me; and now, heſitate at no reproachful expreſſions of malevolence and calumny. Of all the various ill-natured means of detraction, that have yet been deviſed by theſe angry ſages, the moſt remarkable, are the calling my moral and political character, and even mine underſtanding, in queſtion, and attempting to caſt reflections from my late profeſſion.—"Who is this," ſays one, "that is come to decry our waters?"—"A fellow," anſwers another, "that was forced to fly his own country, and will never be quiet, till he is forced to fly this." —To this, I ſhall make no reply. I have been forced to fly my wretched country. But, let the tyrant ſlaves that baniſhed me, tell why; and then, the judicious and diſpaſſionate may diſcern who, by my exile, ſtands moſt diſgraced.—"Ay," ſays a third, "I have heared of him; no body will mind him; a mere mad man!"— How true this charge may be, I ſhall not diſpute: In ſuch an accuſation, my pleading and mine evidence, in behalf of myſelf, muſt weigh equally light. Let then the world at large judge of me; while at Bath, I onely plead, Coram non judice; and, at the ſame time, offer the patients of theſe prejudging ſages, the comfortable aſſurance, that theſe their good doctors are hardly in any danger of ever being mad: For, this extreme, the phlegmatic and the fool alike eſcapes.— However ſome of the Bath doctors may be divided in their judgement upon me, in the laſt inſtance; in another point, which is looked upon as a ſevere reflection, they are pretty unanimous; that is, in pronouncing my name with a, "The Apothecary."— A terrible ſtigma!—I proudly own the charge; I was, I hope,

I hope, I ſtill am, an Apothecary. It had been happy for the public, that they, who caſt this, as a term of reproach, could ſay as much for themſelves: Since it is moſt plane, that he, who is not an Apothecary, and a Chirurgeon, can not deſerve the name of Phyſician. —A child, being aſked, who ſeveral perſons in a room were, pitching upon one in a clergyman's habit, ſayed, "You are a ſcholar;" and upon another in an officer's dreſs, "You are a ſoldier." Upon being reprehehended for impoliteneſs, and inſtructed in their reſpective ranks, he amended his ſpeech, ſaying to one, "O! Sir, I miſtook; you are a biſhop, not a ſcholar; and you are a general, not a ſoldier."— The reader may avoid the application, if he can. And theſe good phyſicians, who probably diſdain to be apothecaries, may let their paſſion gradually ſubſide; when I thus fairly advertiſe them, that their thunder will vaniſh without noiſe, flame, or ſmoak; that their whole train of artillery is uſeleſs; that their maſked batteries muſt be ſilent; when they examine their magazines more accurately, and find that they have nothing combuſtible in all their vaunted ſtores. Their lightening and thunder then, will be found merely theatrical; at moſt, a flaſh of ſmoaky reſin, and the rumbling of a leaden bullet in an empty trunk: Unleſs they have diſcovered the method of making gunpowder without brimſtone.— But come; the anger with the fears of theſe fretted philoſophers will by and by ſubſide; when they muſt ſee, if not wilfully blind, that I went to Bath in queſt of phyſical truths, not private gain; that in pure regard to the public, and for the general honor of the profeſſion, I did, and now thus endeavor to promulge theſe intereſting truths; and eſpecially, when they find, that I do not in fact, decry Bath waters; but ſhew their powers in a different and more juſt light; and if men will then worſhip images, what matters it of what materials the idols are made? Lot's wife is ſurely as good a divinity, as any that can be taken out of the ruins of Sodom or Gomorrha.

morrah. If they muſt have a Pagod, let it be a real, not an ideal one; the ſalt, earth, and metal in the water may ſurely be moulded into a more ſubſtantial, ſolid god, than imaginary, or even real, brimſtone.

But, that the impartial may be able to judge of my blameleſs conduct towards the frighted faculty at Bath, let it be remembered, that mine enquiries concerning their famed waters, were not made in a corner; nor any material experiment or diſcovery I made, kept a ſecret. Let it be noted, that I conceled nothing from any body, that aſked for ſuch information, as I could give in theſe matters; that I never declined making a ſeries of teadious and laborious experiments and demonſtrations, for any that aſked me, and that I publicly, repetedly, deſired a conference with the gentlemen of the profeſſion of phyſic, in hopes of convincing them of their errors, or receiving from them, conviction of mine own: And, that mine offers were not onely rejected, but that I was induſtriouſly avoided, by the generality of thoſe truſty miniſters of the favorite baths of Apollo; while I was in groſs terms, in mine abſence, abuſed by a certain anonymous, anomolous wight, who attempts by force to intrude into the number!

Some may conſtrue this a kind of pride, or ſome contempt of a late Apothecary. But, this muſt appear but an unjuſt conſtruction; if there was no reaſon to apprehend, that that Apothecary crept by illicit ſteps, from the miniſterial branch, to the head of the profeſſion. Beſides, it muſt appear quite groundleſs, when it is conſidered, that the ſacred oeconomy of the healing art is ſo far perverted, at Bath, as well as elſe where, that theſe, once, miniſters of the faculty are treated by the generality of thoſe, that ſhould be their ſuperiors, with ſome degree of ſervile complacency. Of this, I dare ſay, I might have had a neighbour's ſhare, had I followed the profeſſion of pharmacy at Bath. But, theſe ſovereign Rulers of phyſic, theſe Prieſts of the myſteries, and Keepers of the Baths of the Sun, could not bear, I ſhould now be conſidered, either as a phyſician,

ſician, or even as an apothecary among them!— Let the Juſt judge the cauſe, and condemn, if they find, any part of my conduct, towards theſe iraſcible, jealous gentlemen, culpable!

The ſacred regard and deference, ever due to the judgement of ſociety, induces me to think it incumbent upon every man to explane to the world, or aſſign a cauſe for, every part of his public conduct.—The method, I endeavor to obſerve, in this work, as well as time and circumſtances would admit, will, I hope, appear unexceptionable; though I may not always have been found able to purſue it with deſireable ſtrictneſs, accuracy, and conciſeneſs. My firſt care was to obtain and give the reader the beſt idea, I was able to collect and convey, of thoſe bodies, by whoſe means, waters are capable of being compounded. This is done in the IDEA of SALTS.

After this, I endeavor to give the cleareſt idea of water, by explaning the nature and properties of SIMPLE WATER. In which, I do not pretend to be an original; but, gratefully acknowledge, in this, as well as numberleſs other inſtances, having received many and great helps from HOFFMAN, BOERHAAVE, MUSHENBROECK, and others; which I have endeavored to arrange in the fulleſt force, in which I was able to place them, to illuſtrate the ſubject.

This done, I next procede to explane the moſt familiar and rational method of EXAMINING and CHOOSING SIMPLE WATERS in general; in which, I have rather inclined to prolixity, perhaps fallen into repetitions, rather than by a too great attention to conciſeneſs, or a too rigid adherence to formal rules, omit giving the fulleſt information in my power.

This part, if not ſome others, from the ſame cauſe, may probably prove teadious and heavy to the learned in our way, if ever it may hope to fall into ſuch hands. The ſcope was large. The field uncultivated. I ſpared no pains upon it. And, I hope, it will be found to contain, though perhaps in much rude diſorder, a kind of HYDROLOGIA PHYSICO-CHEMICA, if not the whole

art of chemically proving waters, in general, whether ſimple or medicated.

After examining the ſimple waters of the city of London, upon the plan layed down; I thought it juſt to explane the MEDICINAL QUALITIES and USES of SIMPLE WATERS, and the various methods, antient and modern, of adminiſtring or applying them, whether internally or externally. In all this, I ſhall be found indebted to many of the beſt writers, that have gone before me; eſpecially, where I am forced to offer ſome ſketches of phyſiology as well as pathology.

The ſimple, as the baſis of all compound, waters, being thus fully explaned; the nature of the medicated waters becomes more comprehenſible. The tranſition from thoſe to theſe appears eaſy and natural. I begin then, with the moſt common and ſimple impregnations, and purſue the enquiry, a Notis ad Ignota, to the moſt complicated and ſeeming inexplicable compoſitions of mineral waters, that came in my way. Surely, the attempt, if not the performance, may hope for ſome degree of the approbation of the judicious! And none other can be acceptable.

In all this, I have labored to be explicit: Which led me unawares, if not neceſſarily, into repetitions and prolixity. They that will not accept of SWIFT's apology for writing a long letter, may lay aſide the teadious book, which I had not time to ſhorten.

I well foreſee an attempt to write intelligibly to the vulgar in their own tongue, will be condemned by the generality of thoſe, who chooſe to write in the dead languages, and dread nothing more than their works being made to ſpeak Engliſh. The chief cauſe, that ſuch affect to aſſign for this, is the fear of multiplying the ſhameful number of deſtructive quacks, that diſgraces, and tends to depopulate the ſtate; while, with the unthinking, it glances ſome obloquy upon the healing art.

I can not, in all this, agree with theſe learned gentlemen. It is certain, that to thoſe, who are maſters of the Greek and Latin, it is much more eaſy to treat a

phyſical

phyſical ſubject, in either of theſe languages, in which moſt of our original writings are found, than in any of the modern tongues; ours, confeſſedly the moſt copious of all others, not excepted. And, whoever is moſt perfect in our tongue, muſt find it moſt difficult, if not impoſſible, to explane all phyſical ſubjects clearly in a language, which muſt be forced to borrow terms from the original ſources, whence the ſcience ſprang.

But, ſince we have framed or adopted terms, that are become ſufficiently intelligible, why ſhould we heſitate at propagating the knowledge of any, eſpecially of this moſt uſeful of all arts?— Why ſhould we not endeavor to make all ſpeak Engliſh? And if we can not bring ſciences and arts down to our language; what hinders our raiſing our language up to them?

It is feared, by ſuch gentlemen, that it may multiply quacks.— I think otherwiſe. I am not ignorant of the ſufferings of the duped populace in this inſtance. No man can be more ſenſible of the evil, no man more laments the degeneracy, the univerſal depravity, the total perverſion of all order in the oeconomy of phyſic, in theſe kingdoms. It was this firſt moved me to draw my feeble, juvenile pen to ſhew the neceſſity of a reformation[a]. In vane, did our wiſe forefathers divide the practice of phyſic into three parts, giving up to their ſervants the mechanical or miniſterial branches, that the maſters may have more leiſure to attend to the more material, the judicial parts, and to the culture, direction and ſuperintendence of the whole. We have lived to ſee all this reverſed. And all run into confuſion, worſe than primitive! We ſee the ſhops of apothecaries in particular, and their whole province, ſo entirely neglected, that the generality are as ignorant of the real buſineſs of the apothecary, as any of the worſt bred phyſicians can be ſuppoſed; ſo that the beſt preſcriber can hardly

[a] In a pamphlet, intituled PHARMACOMASTIX; or, the Office, Uſe and Abuſe of Apothecaries explaned, &c. Dublin, 1748.

confide in his own preſcriptions; when their effects vary, according to the character of the ſhop, in which they happen to be diſpenſed; whileſt the owner, perhaps without any one of the requiſite qualifications, for any one branch, takes upon him the whole! What ſenſible man does not feel the dire effects of this confuſion?— Who does not wiſh to remedy the preſent, and to prevent the growth of this ſpreading, evil?— I do. And if reaſon and the authority of the legiſlature do not ſoon put a ſtop to this inverted practice; if the apothecaries are encouraged to quit their proper ſtations, by being thought fit, and preſuming to perform the functions of the phyſician, as well as of the chirurgeon; I think it will be incumbent on the phyſicians to moderate their own fees, which may be done, at the ſame time abridging the quantity of medicines, and the expence to the patients; by reſuming the branches, given into unworthy hands, and furniſhing their patients with ſufficient and adequate remedies, prepared under the preſcriber's eye, without any additional charge to the ſick.

This, I propoſe, as one, though the ſevereſt and laſt, remedy. One, by which apothecaries muſt be reduced to their primitive ſtations, and the public muſt be better ſerved; though at the expence of the phyſicians, and to the prejudice of the public in the end; This muſt effectually put a ſtop to one branch of quackery, and prevent the growth of others. But, as it muſt embarraſs both the ſtudy and practice of phyſic, already, in ſpight to the ſtricteſt regularity, too extenſive for the ſhort life of man; I propoſe the trying, as another, and a milder expedient, the writing upon all phyſical matters in as plane Engliſh, as poſſible; as the ſureſt means of expoſing quacks, and raiſing the duly qualified, the real phyſicians, to the higheſt, the deſerved eſtimation. For this, we have the example of our predeceſſors: What Roman phyſician was ever known to write in Greek?—What Greek, in Arabic?—What Arab, in Chaldaic or Hebrew?— None, that we know of:

of: Each wrote in his native tongue. Each was revered in his native country. Thus AVICEN, MESUE, HIPPOCRATES, GALEN, CELSUS, &c. were admired by the then preſent, as well as bleſſed by all ſucceding generations, for the ſervices done their reſpective countries, and mankind in general, in their works.

Let Britons go and do likewiſe.— Let us cultivate our own excellent language, and publiſh whatever we have to offer the public, in the vulgar tongue. This will make it the intereſt of foregners to ſtudy our language; which may thus in time become as univerſal, as our extended dominion on the main.

This can never be thought to ſerve the intereſt of a degenerate race of quacks. On the contrary, it will enable the public to detect their inſufficiencies, as well as their fallacies. Beſides, it is a ſuperficial knowledge in phyſic, that makes men turn quacks, with the ſcanty furniture of a parcel of recipes, or truſt to thoſe, that are not better ſtocked. Enlighten then, their underſtandings further, remove the vane notions of myſteries, in phyſic; ſhew the dignity, the weight, the difficulty of the taſk of preſerving or reſtoring the health of man; and who then, will venture to quack or be quacked?

Theſe, with other reaſons, induce me to offer this eſſay to the public, in my native tongue. And, I hope, mine intentions will make it acceptable to the judicious and public-ſpirited.—— Let the galled jades wince!

As I wiſh to ſee our language further improved than it is, I have taken ſome liberties with the orthography, in which, I am hardly authoriſed by any authentic precedent. For theſe, ſeeming innovations, the public will accept mine apology.

The modern Engliſh is probably leſs of an original, than any living language in Europe: We have borrowed from all the living and the dead. And it muſt ever be much to our honor, and keep us clear of the imputation of plagiariſm, to continue the words, we in-

introduce from foregne tongues, as near the originals, as the too indeterminate idiom of ours will admit.

This will make our language more eaſily acquired by ſtrangers, as it muſt become more intelligible to the learned of all nations. And this will keep us clear of deſpicable Galliciſms, in avoiding the vices of that tongue and people; who, like us, have been forced to inlarge their language, at the expence of others; but have not kept near the original, in ſpelling or pronunciation. Shall we borrow and retain the faults, the corruptions of the French? God forbid!— For my part, I ſhall oppoſe and reject them, wherever I meet them. And in this inſtance, inſtead of taking from them, the words, that they firſt ſtole from other tongues, and mangled without rule or ſenſible deſign; though all our greateſt writers have adopted them, I chooſe to depend upon the original, rather than implicitly receive the corruptions and inelegancies of any new or borrowed tongue, however I find it in faſhion.

But, Galliciſms are not the onely corruptions, crept into our language. Our own poets have taken moſt unpardonable liberties, in miſpelling and otherwiſe lopping, and cropping of words, to adapt them to their rhymes or numbers, or to make them run the ſmoother in their jingling lines; in which the lower claſs eſpecially, have generally been more mindful of ſound than ſenſe. This may be eaſily conceived by reviewing the unnatural participles commonly formed of the verbs, to fix, to mix, to loſe, to toſs, to lop, to crop, and numberleſs others. I ſubmit it to the judicious, whether it be more juſt and eligible to follow blind cuſtom, or to aim at ſome deſign and rule, in theſe matters.

I know, the novelty, the ſeeming innovation, will meet it's objections. And it will to ſome appear moſt daring and preſumptuous, if not impudent, to attempt to ſwerve from the ſpelling, received and eſtabliſhed by the many great authors, which this and the preceding century have produced.

Let

Let it be remembered, that our language, by none other authority, than that of thoſe, who thought fit to write in it, has gradually changed from the days of Chaucer, to the laſt century, perhaps to this. This, upon the whole, has not been condemned: Our tongue is confeſſedly improved. But, no man will ſay it is yet perfect. Let then every writer propoſe his corrections and amendments of our ſtile and diction, to the public; without that religious, or rather blind, attachement to the authority of predeceſſors, with which ſome ſenſible men ſeem pinioned; till the legiſlature ſhall think fit to eſtabliſh a general ſtandard.

In matters of any weight, precedents, which have not their foundations in truth and reaſon, ſhould be of none authority, with men of ſenſe. Otherwiſe, there can be no chance for a reformation in any matter, that has the grave ſanction of time and cuſtom. I hold myſelf no further bound to write as my predeceſſors did, without the concurrence of my little ſhare of judgement, than our poets thought themſelves obliged to follow one another, in theſe inſtances. He, that anſwers himſelf this queſtion; why did not Spencer follow Chaucer; Milton or Cowley, Spencer; or Dryden, Pope or Swift, literally follow the ſteps of theſe? will find mine anſwer for ſwerving a little from the modes, which the authority of ſuch had eſtabliſhed for ſpelling.

Moreover, let it be conſidered, that in moſt of the ſubject matter of the following work, I have the authority of the dead and living writers, almoſt to unanimity againſt me. Shall their authority and the influence of cuſtom ſo far circumſcribe me, that I ſhall not examine this matter, but be obliged to ſubſcribe to all the errors of grey bearded predeceſſors, contenting my ſelf with a Sic voluere patres?— I believe this will hardly be inſiſted on, in the one inſtance, more than in the other.— Except at Bath; where it ſeems, it would be moſt pleaſing to the city, as well as to the guardians of her health, to let their waters be ſuppoſed, as aſ-

ſerted

ſerted to be, impregnated with ſulphur.— Is it not to be deemed moſt audacious to oppoſe the weighty authority of all the learned and great writers on this important ſubject?— Is it not rather brave, juſt and neceſſary to oppoſe the tyrant cuſtom, whereſoever he is found to rear his obſtinate, hoary head, in defence of error or ignorance? This have I done: No more.

It will probably give the ſenſible and humane reader ſome diſguſt, as well as pain, to ſee the long catalogue of errata, that disfigures this work. I wiſh ſuch may not be offended, by finding many more, which the author, for want of time and leiſure, or from a natural partiality and blindneſs to his own faults, muſt have overlooked.

As a farther apology for theſe, I muſt requeſt, it ſhould be conſidered, that this work, though partly begun upon the continent, was undertaken, long ſince my return from my ſtudies abroad; which is now about three years: Since which time, I have given two long, laborious courſes of chemiſtry, and am now engaged in a third. It is eaſy to conceive from theſe, and the ſhare of practice, with which the indulgence of the public has ſince intruſted me; what a variety of avocations from this work, muſt have always attended me. Such errors as might thus be occaſioned, by the printer, by the author, or by both, demand ſome lenity in the correction. But, this is ſubmitted to the judgement of the reader; for whoſe information, I determined to expoſe ſuch errors and omiſſions as occurred to me, as near as might be to the front of the work; where he may read grief with conviction in the author's face.

If any are humane and public ſpirited enough to wiſh this work correct and complete; their corrections and amendments ſhall be moſt gratefully received, and publicly acknowledged, if the book lives to undergo another edition.

THE CONTENTS.

PART I.

Of

Evapo-

Water,

The

These, among other necessary CORRECTIONS, to be made in the reading, as follow.

PART I.

Idea of SALTS.

PAGE 2. line 3. and every where else, for it, read it's.
§ 5. l. 3. for floating, r. floting.
§ 6. l. 5. for exceeding, r. exteding.
§ 12. l. 9. for deo, r. do.
§ 13. l. 5. for remaining, r. remaning.
22. l. 4. and every where else, for distillation, r. distillation.
§ 30. l. 2. for only read onely.
§ 40. l. 2. and every where else, for arteficial, r. artificial.
§ 43. l. 14. for Æthiops, r. Aethiops.
§ 45. l. 11. after with, add, some.
§ 47. l. 12. and every where else, for grains, r. granes.
§ 54. l. 9. for in this acid, r. therein.
§ 56. l. 30. for colour, r. color. and every where else, in this and similar words, strike the u, out of the last syllable.
§ 65. l. 7. and every where else, for crystalins, r. crystalline.
§ 66. l. 12. for resborbs, r. reserbs.
§ 67. l. 2. 2. for abbent, r. absorbent.
§ 77. l. 10. for larger, r. layer.
l. 21. for pellicle, r. pellicule.
§ 87. l. 4. for succeed, r. succede.
§ 230. l. 12. afer, if, add, into.
l. 13. after dropped, d. into.

Of WATER *in general.*

§ 10. l. 3. for particles, here and else where, r. particules.
l. 5. for float, in general, r. flote.
§ 20. l. 2. for freeze, r. freese.
§ 22. l. 12. for heighth, r. highth.
§ 24. l. 7. and elsewhere, for mountains, r. mountanes.
§ 27. l. 5. for lie, r. lye.
l. 8. for consideration, r. considerations.
l. 18. after are, add, often.
§ 30. l. 4. for least, r. left.
l. 10. after and, add, thence.
§ 32. l. 14. for latter, r. later.
§ 45. l. 9. for whilst, r. whileſt.
§ 49. l. 7. for bodies, r. subjects.
§ 68. l. 3. after oils, add, and acids.
l. 25. for liquidity, r. fluidity.
§ 77. l. 1. after two, add, half ounce.
§ 80. l. 24. after heat, add, in the natural air.
in the note, for losed, r. lossed.
§ 97. l. 16. after water, add, be.
§ 101. l. 1. and elsewhere, for soap, r. sope.
§ 111. l. 6. after by, add, agitation, or by
§ 115. l. 24. § 496. l. 2. for niter, r. nitre.
§ 121. l. 4. for temperament, r. temperature.
§ 122. l. 44. after for, r. such as can be.
§ 135. l. 5. after a, add, kind of
§ 142. l. 15. for sc perabundant, r. superabundant.
§ 152. l. 5. for bett r, r. better.
§ 178. l. 24. for to, r. in.
§ 190. l. 20. instead of for, r. to
§ 190. l. 21. for water, r. waters.
§ 209. l. 4. § 212. l. 3. § 213. l. 7. and universally, for heightened, r. highthened.
§ 218. the paragraph following is to be numbered, § 219.
§ 224. l. 32. after fixed, add, especially, in an advanced proportion.
§ 225. l. 15. for these, r. those.
§ 230. l. 12. after if, add, into.
l. 13. after dropped, d. into.
§ 245. l. 14. for cracking, r. crackling.
l. 34. for pelucidity, universally, r. pellucidity.
§ 246. in note; after STARL, add, &c.
§ 247. l. 8. for fleaks, r. flakes.
§ 251. l. 6. for which, r. that.
§ 287. l. 12. after be, add, partly.
§ 300. l. 2. for su ers, r. suffers.
§ 364. l. 12. for those, r. these.
§ 379. l. 6. for overrun, r. overran.
l. 14. for whereby, r. whence.
§ 382. l. 4. for title, r. titule.
§ 385. l. 14. § 452. l. 17. and elsewhere, for muscles, r. muscules.
§ 389. l. 5. for they be, r. the fluids be.
l. 6. after and, dele are.
§ 391. l. 1. for osphysiology, r. of physiology.
§ 393. l. 5. before infinitely, r. almost.
§ 395. l. 2 for exceeding, r. exceding.
l 8. after one, add, third.
l. 10. after parts, add, in three.
§ 393. l. 17. § 401. l. 30. and elsewhere, for humours, r. humors.
§ 401. l. 10. and in all like instances, for intolerable, r. intollerable.—&c.

§ 402

ERRORS

§ 402. l. 26. for tolerable, r. tollerable.
§ 403. l. 24. for Allem, r. Alum.
§ 404. l. 2. for Schlangenbad, r. Schlangenbadt.
§ 414.. l. 7. for fit, r. fits.
§ 422. l. 14. for, Nor were they frustrated in their expectation, r. Nor were their expectations frustrated.
§ 425. l. 25. for favour, r. favor.
§ 431. l. 2. after the, r. different.
§ 433. l. 26. for least, r. left.
§ 454. l. 28. for vigour, r. vigor.
l. 30 for ARISTOTLE, r. ARISTOTLE.
§ 458. l. 28. for chiefly alcaline, r. chiefly alcaline.
§ 460. l. 17. before impatient, r. in.
l. 22. for prevail, r. prevale.
§ 464. l. 15. for frozen, r. froſen.
§ 464. l. 52. for out, r. our.
§ 472. l. 26. for practitioner, r. practicioner.
§ 495. l. 17. for molified, r. mollified.
§ 506. l. 5. for were, r. was.
§ 518. l. 17. for visidity, r. viscidity.
§ 521. l. 5. for frensy, r. phrensy.
§ 523. l. 15. § 525. l. 6. and elsewhere, for judgment, r. judgement.
§ 541. l. 2. after and, add, this,
§ 555. l. 6. 24. and elsewhere, for absent, r. absinth.
§ 557. l. 1. for rheumaticking, r. rheumatic.
§ 573. l. 2. after ground, add, this kind of,
§ 582. l. 5. for cumeal, r. cumole.
§ 595. l. 21. before barrels, add, ing.
§ 596. l. 2. after quantity, add, or more;

A

General Idea of SALTS,

INTRODUCTORY TO

An Essay on WATERS.

§ 1. THE universal creation is divided by naturalists into three distinct classes, which they call kingdoms: 1. The mineral, 2. The vegetable, and 3. The animal.

§ 2. 1. By minerals or fossils, we understand all those natural bodies, that compose the terraqueous globe, whether found in the bowels, or upon the surface, of the earth, having no perceptible organs or vessels, but owing their generation and formation entirely to some external cause; such are water, earths, stones, mines or ores, metals, salts, sulphur, bitumen, coal and the like.

§ 3. 2. By vegetables, is understood a class of natural bodies, so called, from their perceptible growth, in contradistinction to minerals, which can have no vegetation, for want of proper organs. These are hygraulic bodies, consisting of an infinite number and variety of vessels, which contain and circulate different juices or fluids, absorbed partly by the roots, where-

by they adhere to the earth or other bodies, and thence imbibe their groſſer nouriſhment, the matter of their accretion, and partly from the atmoſphere, by the pores of the leaves, buds or bark. Under this head, are comprehended all herbs or plants, ſhrubs or trees, and their different parts and productions.

§ 4. 3. The animal, ſo called from its having life and motion, is an hygraulic body, which, like the vegetable, is qualified to take in the matter of nutrition and accretion, partly from groſſer ingeſted elements, by veſſels within itſelf, bearing analogy to the roots of vegetables; partly of a more ſubtil kind, from the air by the lungs, or by the pores of the ſkin; and ſubſiſts by a continual determinate motion of fluids, elaborated within itſelf, through certain canals; the ſeveral parts of its body being, at ſome time of its exiſtence, vaſcular.

§ 5. To theſe, ſome add a fourth claſs or kingdom, the atmoſpheric, or meteoric; but this ſeems not very material; ſince all the bodies we find floating in that fluid, may be traced from their original ſource, the earth. However, ſuch bodies as we receive immediately from thence, we diſtinguiſh by theſe names; as meteoric or atmoſpheric ſalts, waters, *&c.*

§ 6. However inconceivably great the number and variety of natural bodies, to all thinking men, muſt appear, the philoſophical chemiſts hold them to be all ſeverally compoſed of certain principles, or material eſſences, not exceeding four in number. Theſe primary eſſences or conſtituent particles of bodies are deemed infinitely ſmall and indiviſible, perfectly ſimple and homogene; endued with certain determinate forms, though from their extreme minuteneſs, imperceptible to our ſenſes; and with certain properties and qualities, as gravity, attraction, repulſion, *&c.*

§ 7. Theſe ſeem to have been confuſedly known, though better conceived than deſcribed, by the antients. All philoſophers have acknowledged, firſt principles or primary eſſences of bodies, under one name or other.

ther. These were the elements of the Peripatetics; the atoms of Democritus; the monades or unitates of Pythagoras and others; the materia prima of Des Cartes, and the hard primary particles of our immortal NEWTON.

§ 8. BECHER has thrown the clearest light upon this subject. The four principles, he enumerates, are,

§ 9. I. The humido-fluid, or aqueous element;

§ 10. II. The dry dense principle, which consists of three kinds of earths, as he calls them; these are,

§ 11. 1. Terra prima, the primary, or vitrifiable earth; which he looks upon as the basis or matrix of all other earths, and conceives to be the salt principle of the antients, as it is found the true basis of all known salts.

§ 12. 2. Terra secunda, φλογιστον, Phlogiston, the second or inflammable earth or principle, the pabulum ignis, food or fewel of fire; to the antients but obscurely known, under the name of sulphur, in the enumeration of the principles of bodies. But, the moderns by this understand a perfectly pure and simple elementary matter or principle; the cause of inflammability, of colors and odors in all bodies: vegetables and animals abound with this principle; so doe sulphur, coal, and all bituminous matter; and no minerals are perfectly exempt from it. It is one and the same in the subjects of the three kingdoms. No subject parts with its phlogiston in any degree of fire, if air be excluded. Metals deprived of it are reduced to calces, and lose their metallic splendor, fusibility, ductility, and other properties; upon restoring this, they are revived into their pristine form, with all their properties. To give one familiar instance for all. Lead by calcination loses its phlogiston, and becomes a red calx or mineral earth. If this be fluxed with any inflammable body, oil, pitch, wax, fat, wood, bone,

or mineral oil or bitumen, it reſorbs the inflammable principle, and becomes perfect lead as before. But, to give an experiment within every perſon's compaſs. Let a red ſealing wafer be ſet on fire in the flame of a candle, and then held over a piece of paper; it will be found as it burns to hiſs and ſparkle, and then little globules of melted lead will drop upon the paper. The reaſon of which is, the wafer is colored with read lead; to this either the burning flower in the compoſition, or the flame of the candle, or both, give what the calx wants to complete or reſtore the metal, the inflammable principle, which this ſhews to be the ſame in all bodies. And this we mean, whenever the inflammable principle, the ſulphureous principle or phlogiſton, is mentioned in this eſſay or elſewhere.

§ 13. 3. Terra tertia, the third or mercurial earth, or metalliſing principle, from which metals derive fluidity, without humidity; by fire, fuſing or running with it, as fluid, yet as dry as mercury or quickſilver; without it, remaining infuſible earths, calces, in the ſtrongeſt fire. This may be the principle, called by others, mercury, or ſpirit. It generally accompanies the phlogiſton, from which it ſeems inſeparable.

§ 14. Should I enter upon the demonſtration of the being and attributes of theſe principles, it would lead me into a diſquiſition too remote from my ſubject, and too tedious to the reader, whom I muſt, for further ſatisfaction, refer to the works of BECHER, STAHL and HOFFMAN. Here, it muſt ſuffice to ſay, that, from different combinations of theſe four principles, or ſome of them, in various proportions and manners, all created beings are held by modern philoſophic chemiſts to be originally produced; and that into ſome or all of theſe principles, all bodies are reducible, by art, as well as nature; and that there is in nature, a conſtant regular ſucceſſion of creation or generation, and corruption or reſolution of bodies throughout the univerſe, from, and into, theſe principles;

ciples; for, the deſtruction of one body becomes the means of generating an other.

§ 15. Thus far I held it neceſſary to give a chemical idea of the diviſion of natural bodies, and a general notion of their creation and reſolution. More does not properly come within the ſcope of my preſent intention, which is only to inquire into the nature and properties of water. But, before I enter upon that ſubject, I ſhall endeavor to explane the nature and properties of ſalts in general, as the principal means, by which water becomes compounded, as well as the chief inſtruments in exploring the compoſition of that fluid.

§ 16. By ſalt, we underſtand a body which is ſapid or ſavory, that is, imprints in ſome degree a ſenſe of corroſion or irritation upon the palate, from its ſolubility, without which it could impart no taſte. Salts therefore in general are ſoluble in water, and fuſible in the fire, and miſcible with ſuch earths as bear affinity to their particular baſe.

§ 17. Every ſalt is looked upon to conſiſt of the aqueous principle, united with the firſt or vitrifiable earth; ſometimes with that alone, and ſometimes compounded with one or more of the terrene principles; whence the great diverſity of ſalts ariſes.

§ 18. The chief criterion of ſalts, their great attraction with, and ſolubility in water, is derived from their firſt principle, the aqueous; and their ready union with ſome other terrene bodies and promoting their ſolution alſo in water, ariſes from the attraction their terrene principles hold with other ſimilar bodies.

§ 19. There is a very great variety of ſalts, which are differently diſtinguiſhed, the one from the other.

§ 20. I. Firſt, they are diſtinguiſhed, from the manner of their production, into natural and artificial, or ſuch as partake of both.

§ 21. 1. The natural, are thoſe, that are found in the natural bodies of the different kingdoms, ſpontaneouſly produced.

§ 22. 2. The artificial, are thoſe, that are extracted or elaborated by art out of any of the natural bodies, by ſolution or elixiviation, by incineration, fermentation, putrefaction, diſtillation or other operation of art; to which may be added,

§ 23. 3. Such as are partly indebted to nature, and partly to art, for their production; as modern nitre, *&c.*

§ 24. II. The ſecond diſtinction of ſalts ariſes from the bodies or kingdoms, whence they are produced or extracted; theſe are 1. Mineral. 2. Vegetable. 3. Animal.

§ 25. 1. Such ſalts, as are found in the earth, or made or extracted from any foſſil body, are called mineral. From this ſource, all ſalts are found to have deduced their origin, however they be ſeen in other bodies altered and diverſified.

§ 26. 2. All ſalts, that are by any means made or extracted from any vegetable body, are diſtinguiſhed by the appellation of vegetable ſalts; as,

§ 27. 3. Thoſe that are drawn from any animal body, are called animal ſalts.

§ 28. III. Salts are likewiſe diſtinguiſhed by their different degrees of permanence or fixedneſs in the fire or open air, into

§ 29. 1. Fixed ſalts, which ſuffer no eſſential alteration in pure air, no loſs of ſubſtance by the utmoſt degree of heat, unleſs flame be reverberated upon them; as all the fixed ſalts, made from the aſhes of calcined vegetables.

§ 30. 2. Volatile ſalts, which are not only ſet in motion and diſſipated by the ſlighteſt heat, but fly off if expoſed to the open air; as ſalts extracted by putrefaction or diſtillation of vegetable or animal bodies, and the like.

§ 31. 3. Semifixed or semivolatile, which ſtand the open air, and ſome degrees of heat; yet, by fire, in cloſe veſſels, may be raiſed from the bottom to about the middle or upper part of the veſſel, where it will again run into its priſtine form. Such are the ſalts called ammoniac, and the like.

§ 32. IV. But the moſt material diſtinction of ſalts, for our preſent purpoſe, and that which beſt deſerves our preſent attention, is their diviſion into, 1. Acid, 2. Alcaline, and 3. Neuter ſalts.

§ 33. 1. The acid ſalts are known to all by the taſte; which is alſo called in our language, ſour, and are common throughout the whole face of nature; they are denominated from the ſeveral kingdoms whence they are drawn, 1. Mineral, 2. Vegetable, and animal.

§ 34. 1. The mineral acids are threefold;

§ 35. The firſt is that vulgarly denominated from the mineral ſubſtances whence it is moſt commonly extracted, the acid of ſulphur or vitriol or alum, generally known by the names of ſpirit, or oil of vitriol or ſulphur. This is the univerſal acid, that pervades the whole creation. It is called aerial and ætherial, from its abounding in a volatile form, in theſe regions; and primogenial, from its being the original ſource, from whence all other acids ſpring. This is judged to be compoſed ſimply of the aqueous principle and the firſt, or mineral vitrifiable earth, united. This is found either volatile or fixed, in nature, as well as by art.

§ 36. The ſecond is the acid of nitre, vulgarly called ſpirit of nitre, or aqua fortis. This is by art extracted from the ſubject, whoſe name it bears, modern nitre or ſalt-petre, and is judged to conſiſt of the firſt, the univerſal acid, moſt ſubtilly attenuated by the phlogiſtic or inflammable principle, by the means of putrefaction. It is never found pure in nature; being always found adherent to ſome terrene or ſaline

baſe. Wherefore, in this form, it is ever to be looked upon as a creature of art.

§ 37. The third is the acid of ſea ſalt, called alſo vulgarly its ſpirit. This is extracted from the ſubject whoſe name it bears, by the ſame means as the acid of nitre is drawn; and is judged to conſiſt of the univerſal acid, ſubtiliſed by its union with the third earth, or mercurial principle; whence its aptitude to volatiliſe certain metals and metallics. This is never found pure in nature, more than the acid of nitre; but, like that, is found united in its proper ſubject with a mineral alcali, or like the acid of nitre, with a calcarious baſe: ſo that, like the preceding, in this form, it is to be looked upon as a child of art.

§ 38. 2. The ſecond general claſs of acids is the vegetable. Theſe are either, 1. Native, or, 2. Artificial.

§ 39. 1. The Native acids are the juices of various plants, as well as fruits; ſuch as thoſe of the dock and common ſorrel kind, as well as wood-ſorrel and others; thoſe of berberies, gooſeberries, corinths, cherries, apples, pears, oranges, lemons, and the like. To which may be added, thoſe acid liquors, which by diſtillation, in a naked fire, are obtained from moſt vegetables, eſpecially the hard woods. Theſe are all judged to ariſe from different combinations with, or modifications of, the univerſal acid.

§ 40. 2. The Artificial acids are thoſe obtained, by the means of fermentation, from the ſweet, as well as auſtere and other tafted, juices or infuſions of vegetable productions; as cyder, perry, wine, mead, beer, and the like; or thoſe, from theſe produced by the ſecond ſtage of fermentation, vinegar; to which may be added, that acid ſaline concretion called tartar.

§ 41. 3. The third general claſs of acids are thoſe, called animal. Such are the gaſtric juices of moſt animals, as rennet; and the acid, which, by waſhing or diſtillation, may be obtained from all inſects armed with ſtings, particularly ants. To which may be added, the acid demonſtrated by HOMBERG in the diſtillation

tillation of blood, and that from urine in the nitrous salt *, the basis of phosphorus.

§ 42. 2. The alcaline salts, so called, from having been first extracted from the herb kali, to which al being prefixed implies no more, than the article ὁ, ἡ, τό, of the Greeks, le or la of the French, or the, of our language; as if one should say, the kali or the glasswort. These have a taste the reverse to that of acids, with which they do not mix without a contrast and ebullition, and upon mixture generate neuter salts. The alcaline salts are,

§ 43. First, fixed; which may be distinguished into Native or Mineral, and Artificial or Vegetable. The Native or Mineral alcali is the basis of common salt, the nitre of the antients, not unlike the soda or kelp of the moderns, or the alcaline salt found in most mineral waters. The Artificial or Vegetable alcali is that, which is obtained by the incineration or calcination of any herb, shrub, tree, or other vegetable production; except such as yield a volatile alcali; these afford no fixed salt; and the marine and submarine plants, whose salt is of the nature of the native or mineral alcali. To this class belongs that fashionable medicine, to which a whimsical and unmeaning name is given, Æthiops vegetabilis: this, called by whatsoever name it may, is none other than soda or kelp, the alcali of the antients. Fixed alcalies are judged to be composed of the vegetable acid, with a small portion of phlogiston united with the vegetable vitrifiable earth.

§ 44. Secondly, volatile alcalies; these are obtained by putrefaction, or combustion of all vegetable and animal bodies, by distillation of some vegetables, such as the cress, radish and mustard kinds, the onion tribe, &c. that of soot, and that of all animal bodies in general. And is supposed to consist of a saline substance, subtilised by the union of the inflammable principle, chiefly by means of putrefaction or fire. But there is, besides this artificial, a natural kind of volatile alcali,

* See J. A. Schlosser, M. D. Leyd. Dissert. inaugural. de Sale nativo Urinae. Lugd. B. 1752.

attributed

attributed to the place whence it is obtained, the mineral kingdom. This is of too volatile a nature to be found pure alone; it is always united or incorporated with mineralised vegetable or animal bodies; such as different petrifications of those substances. Some doubt its existence in nature; but, with what propriety may be judged from the native sal ammoniac, which like the artificial, consists of a volatile alcali, and the acid of sea-salt.

§ 45. 3. Neuter salts are those that are composed of acids and alcalies, but partake of the nature of neither; being a third substance, resulting from the mixture, which is of a middle quality, quite neuter; whence they are called salia neutra, media and enixa. Of these there is an almost infinite variety, from combinations of all the different acids with all the various alcalies, as shall be further explained in the sequel. To these some add the saline concretions resulting from the solutions of various earths and metals in acids, calling them compound, terrene, or metallic salts, but with impropriety.

§ 46. Omitting various circumstances in these bodies, which relate to natural history, and natural philosophy in general, to chemistry in particular, I shall procede to those properties of salts, which more immediately relate to our present purpose. And

§ 47. 1. With respect to the acids; these all readily unite with water, because they all abound with that principle: for, by accurate observations of HOMBERG and BOERHAAVE, the strongest and heaviest acid, the most concentrated oil of vitriol, does not contain above one half genuine acid, the other being entirely water. Spirit of nitre consists of somewhat above one fourth of pure acid, and somewhat less than three fourths water. Spirit of sea-salt contains better than a sixth of the acid, the rest is pure water. And in one ounce of distilled vinegar, there are but about eighteen grains of acid, the rest is water.

§ 48. Acids, from the attraction between their terrene base and other earthy bodies, dissolve and unite

with

with various earths, according to their different degrees of affinity. As ſolvents, they all act with different force and effects upon fixed and volatile alcalies, upon the groſſer earths, ſofter ſtones, and the ſhells of fiſhes. They all moſt ſtrongly attract, and conſequently ſooneſt diſſolve or unite with, 1. the fixed alcalies, and of theſe, the vegetable, rather than the mineral; 2. the volatile alcalies; 3. the abſorbent earths, and of all others quicklime; 4. after that, egg-ſhells; 5. crabs eyes; 6. and laſtly, chalk.

§ 49. Moſt metals, and metallic ſubſtances, are likewiſe in different manners and degrees affected by theſe acids.

§ 50. All the acids, whether mineral or vegetable, are more or leſs capable of diſſolving zinc or ſpelter, and, in ſome manner, lapis calaminaris, or cadmia; in our language calamine, calamy, or cadmy.

§ 51. The vitriolic acid is by itſelf capable of diſſolving not only zinc, but iron and copper; and, with ſome management of art, to which nothing in nature is yet found analogous, quickſilver, ſilver, tin, lead, and regulus of antimony.*

§ 52. But, the order of attraction, and general diſſolving power of this acid, ſtands thus; 1. with the inflammable principle; 2. with fixed alcalies; 3. with volatile alcalies; 4. with abſorbent earths; 5. with zinc; 6. with iron; all which it attacks with ſuch force and rapidity, as to diſſolve them with eaſe and ſpeed; 7. then ſlowly and difficultly copper, and not without peculiar management; 8. lead; 9. quickſilver; 10. ſilver; 11. tin; 12. regulus of antimony; wherefore we find no natural ſolutions of theſe, 8, 9, *&c.* in this acid.

§ 53. The nitrous acid diſſolves, together with the incomplete metals, zinc, quickſilver, regulus of, but not crude, antimony, all the metals complete and perfect; except gold.

§ 54. But, the order of its attracting and diſſolving power, ſtands thus; after the alcaline ſalts and terrene

* Stahl de ſalibus.

ſubjects,

ſubjects, which it affects in much the like manner and order as the preceding acid, it moſt readily attracts and diſſolves, 1. zinc; 2. iron; 3. copper; 4. lead; 5. quickſilver; 6. ſilver; 7. tin; 8. regulus of antimony. But, as this acid is never found pure in nature, we are not to look for any natural ſolution of theſe metallic ſubſtances in this acid.

§ 55. The acid of ſalt attacks and diſſolves the alcaline ſalts and terrene ſubſtances, in common with the other acids, and likewiſe the metals, complete and incomplete; but in a different order and manner from the others; 1. it moſt readily diſſolves iron; 2. more readily than the vitriolic acid, diſſolves copper; 3. tin; 4. regulus of antimony; but, 5. more tardily and difficultly, lead; and 6. moſt difficultly, ſilver; 7. quickſilver, and united with the nitrous acid, when it conſtitutes the ſolvent called aqua regia, not otherwiſe, it diſſolves gold. Yet ſome of theſe metals and metalics, with which it is ſuppoſed to correſpond, in the conſtituent terrene, the mercurial, principle, it cannot diſſolve, unleſs in the concentrated ſtate, or when they are firſt divided or diſſolved by other ſolvents. Thus it precipitates ſilver and lead diſſolved in the acid of nitre, unites moſt intimately with the magiſteries, and renders them volatile; it precipitates mercury diſſolved in the ſame acid, but ſoon after rediſſolves it; and being in the concentrated ſtate united with tin, regulus of antimony, or quickſilver, it renders them likewiſe volatile or ſemi-volatile.* The order of its attraction, as determined by M. Geoffroy in his table of affinities, ſtands thus; 1. tin; 2. regulus of antimony; 3. copper; 4. ſilver; 5. quickſilver; and---8. gold. But, it muſt be remembered, that the abſorbent earths, as well as the fixed and volatile alcalies, precipitate theſe bodies, diſſolved in this ſolvent; and particularly mercury ſublimate, which, with the fixed alcali, gives a brown orange colour, with the volatiles a very white magiſtery. It is alſo to be remembered, that

* § 37.

this

this acid, no more than that of nitre, is found diſengaged from an alcaline or terrene baſe in nature; and that therefore we are not to look for metallic ſolutions in this acid, more than in that of nitre, ſpontaneouſly or naturally.

§ 56. In all theſe caſes, the firſt in the order is reckoned to ſtand firſt in the claſs of affinity, or attraction, with the ſolvent. The firſt then, interpoſing between the ſolvent and the ſecond, will diſſolve the union, cauſe a ſeparation and precipitation of the ſecond, or leſs attracted, and take its place. Thus will the ſecond precipitate or ſeparate the third, the third the fourth, and ſo on; as ſhall be further explaned in giving the method of examining waters by precipitation. See the trial and choice of waters.

§ 57. Let us next conſider the effects produced by the unions of theſe different ſalts, the one with the other, or with divers terrene and metallic bodies.

§ 58. All the acids attack all the alcaline ſalts and abſorbent earths, and the mineral acids in particular, moſt metals, with ſuch rapidity, as to cauſe an effervescence, with a frothy ebullition; but differing in degrees. When the conflict ceaſes, and is not revived upon the addition of new matter, the point of ſaturation is ſaid to be hit, and the ſolvent is then charged with as much of the ſolvend, as it is capable of ſuſtaining in a ſtate of perfect ſolution and neutrality.

§ 59. From theſe ſolutions, different taſtes and other qualities ariſe. All the acids, upon being charged with alcaline ſalts, or abſorbent earths, lay aſide their acid taſte and corroſive quality, and put on a ſaline taſte, with more or leſs bitterneſs, and become inoffenſive to the taſte or touch. Theſe are neuter ſalts.

§ 60. To this there is one exception; the vitriolic acid charged with a certain earth, of the limo-cretaceous kind, conſtitutes that auſtere, rough ſtyptic, called alum.

§ 61. The ſame acid, with iron, yields a mild, ſweetiſh ſtyptic; with copper, a ſeptic; and with mercury, a cauſtic.

§ 62.

§ 62. The acid of nitre, with lead, affords a ſweetiſh ſtyptic; with copper, quickſilver and ſilver, ſeptics and cauſtics.

§ 63. The acid of ſalt, with iron, conſtitutes a ſtyptic; with regulus of antimony, a powerful ſeptic; and with mercury, a formidable cauſtic.

§ 64. All the mineral acids, with all the alcaline ſalts, run into ſalts of certain and determinate cryſtaline forms, and may be ſo kept of a dry and ſolid conſiſtency: whereas, with all the abſorbent earths, they either retain their liquid form, or, being by force of fire reduced to a dryneſs, they attract the humidity of the air, and deliqueſce or run liquid again; except the vitriolic acid, with lime, chalk, or other calcarious earth; and the baſis of alum, with which it preſerves a dry and ſolid form in the ſelenite, as well as in the alum.

§ 65. The vitriolic acid, with fixed, native, or mineral alcali, forms the neuter ſalt we find in moſt mineral waters, which is analogous to Glauber's or Epſom ſalt; with the fixed, artificial, or vegetable alcali, tartar vitriolate; with volatile alcalies, Glauber's ſecret ſalt ammoniac; with all the metals, it is capable of diſſolving, it forms a dry, cryſtaline ſubſtance, eſpecially with iron and copper, which gives us the green and blue vitriols of theſe metals; but this is only to be underſtood of the groſſer or heavier vitriolic acid: that, which is ſubtiliſed and volatiliſed, retains the principal properties of the heavier or more fixed; it preſerves its affinity or attraction, diſſolves metals, earths, and ſalts; but is ſo volatile, as to fly off and quit every body, with which it ever united, upon additional heat, or the interpoſition of the heavier acid; except that, with which it has the ſtrongeſt attraction, the phlogiſton, with which it moſt firmly and intimately unites, and forms that ſemi-volatile concrete, called ſulphur or brimſtone. From the ſolutions of iron, wrought by the means of this volatile acid in the mineral waters, it readily flies off, leaving the iron to precipitate in the form of a martial earth.

Hence

Hence arose the false notion of a volatile vitriol, so universally, so absurdly prevalent.

§ 66. The acid of nitre, with the mineral fixed alcali, gives a kind of nitre, whose crystals are quadrangular; with vegetable fixed alcalies, gives pure nitre, of which a vegetable alcali is the base; this is called regenerated nitre. It likewise unites and gives a saline concretion with the volatile alcali, which is hardly reduced to a crystaline form, and partakes partly of the nature of sal ammoniac, partly of nitre. This acid, with silver, quicksilver, and lead, runs into firm crystals; but with iron, copper, and tin, it preserves its liquid form, unless the humidity be separated by force of fire; soon after which, it reabsorbs from the air enough to liquefy itself again.

§ 67. The acids, with the pure alcaline salts and absent earths, cause no remarkable change of color; but, with the metals, various differences arise.

§ 68. The acid of vitriol, with iron, gives a dark grass-green, brighter in its crystals; with copper, a bright sapphirine blew, deeper in its crystals.

§ 69. The acid of nitre, with iron, produces a color between yellow and a reddish brown; with copper, a pale or sky-blew; with silver no color, except when it is allayed with copper; then it acquires the color proper to this metal.

§ 70. The acid of salt, with iron, produces a color between a yellow and a green; which solution, upon standing, deposites a blackish sediment; which, upon the addition of new spirit of salt, tinges a kind of orange color. This acid, with copper, gives a bright emerald color, which by time becomes more and more obscured with brown. If this acid be mixed with the nitrous acid, in any proportion, it constitutes aqua regia, in which copper dissolved gives a green, and gold, its natural color.

§ 71. The forms of the crystals produced by these combinations, sufficiently characterise them.

§ 72. The

§ 72. The cryſtals reſulting from the ſaturation of the vitriolic acid with any fixed alcali, conſiſt of eight ſides, and terminate in obtuſe or broken pyramidal points. Such are the cryſtals of tartar vitriolate, &c. And theſe are infuſible, ſtanding the fire unaltered. Thoſe ariſing from the union of this acid with the mineral alcali, or baſe of ſea-ſalt, bear a different aſpect, which makes them an exception to this rule. They nearly approach to the figure of the hexagonal priſms, which nitre affords; but that they chiefly cryſtaliſe horizontally in the liquor; whereas the cryſtals of nitre run in all directions. This ſalt is exceeding fuſible.

§ 73. The cryſtals of vitriol of iron are of the figure, called parallelopiped; the ſides and angles ſtanding oppoſite to each other.

§ 74. Cryſtals of vitriol of copper exhibit the like form; but the ſituation of the ſides and angles, with reſpect to each other, are more uncertain and indeterminate.

§ 75. The cryſtals, ariſing from the ſaturation of the nitrous acid with any artificial fixed alcali, exhibit the ſame form with thoſe of nitre, hexagonal priſms, whereof two oppoſite ſides excede the reſt in equality of ſurface, as well as in breadth; each priſm terminating in ſuch a point, as any of the cryſtals cut obliquely, tranſverſly, from one broad ſide to its oppoſite, would expreſs. This is nitre regenerated. But the ſame acid, ſaturated with the native alcali, yields quadrangular cryſtals.*

§ 76. This acid gives different cryſtals with the different metals ſoluble in it, which are reducible to a cryſtaline form. Thus with lead, it forms cryſtals of different figures, from eleven to twenty ſix ſides; whereof one, which is the under ſide, is broad and flat, the reſt cut into various ſides of various forms, upon an hexagonal and ſometimes upon an octagonal

* § 66.

baſe;

base; with silver, thin, flat, and indented plates or scales are formed; with quicksilver, pointed, spear-formed crystals; and with silver and quicksilver together, shrub or tree-formed crystalline concretions, the much talked of Diana's or the philosopher's tree, are produced.

§ 77. The acid of sea-salt, saturated with either the vegetable or the mineral fixed alcali, which is its proper base, gives crystals, which are commonly, but improperly, called cubical: for, they are composed of small square pieces of equal lengths, which, uniting at the extremities, form a true square figure; from this, another square, of a smaller size, issues; to this, a third adheres, and so on to a fifth or sixth, always diminishing till it ends in a seeming cubical figure. Thus every crystal of salt is formed from the first larger, which is the pellicle, to the last or lowest; and so forms an inverted pyramid. This is the regeneration of sea-salt. But, with a volatile alcali, with which it constitutes salt ammoniac, it yields long, slender, plume-formed crystals.

§ 78. Let us now consider these mineral acid salts, with respect to their different powers of attracting, dissolving, and holding bodies in solution.

§ 79. It is found, by experience, that the vitriolic acid engages any alcaline salt, and retains it more firmly, than that of nitre or salt does the same basis. The attraction then of this acid to a fixed alcali, is stronger than that of nitre; and that of the acid of nitre, to the same base, is stronger than that of salt; the acid of salt is stronger than that of vinegar, and so on.

§ 80. These positions are at once explained and proved, by the following experiments:

§ 81. 1. Let the acid of sea-salt be saturated by the addition of a sufficient quantity of a fixed, vegetable alcali, and a salt in most respects corresponding with

ſea-ſalt will be generated. This proves the conſtituent parts of ſea-ſalt to be this ſpecific acid, and an alcaline, ſaline baſe. The reſult of this compoſition is called, regenerated ſea-ſalt.

§ 82. 2. To this ſalt, in a glaſs retort, let the acid of nitre be added; this will more ſtrongly attract, and be attracted by, the alcaline baſe of the firſt ſalt, than that was by the lighteſt and weakeſt of the mineral acids, that of ſea-ſalt; whence, upon adminiſtering the proper degrees of heat, the acid of ſea-ſalt will diſtil in white fumes, not quite free from the very volatile red fumes of the nitrous acid. This will be a kind of aqua regia, the acid of ſea-ſalt, with ſome portion of the nitrous acid. In the retort will remane a white ſaline maſs, conſiſting of the nitrous acid united to a fixed vegetable alcaline baſe; this, by ſolution, evaporation, and cryſtalliſation, yields regenerated nitre, perfect ſalt-peter.

§ 83. 3. If to this ſalt, in another retort, a ſufficient quantity of the vitriolic acid be added, this will ſeiſe the alcaline ſalt, that alternately ſerved for a baſe to each of the preceding ſalts; and, the nitrous acid being thus ſet free, it will readily diſtil, as the acid of ſea-ſalt did before. And now we have the alcaline baſe united with the vitriolic acid, which by cryſtalliſation gives us tartar vitriolate. An infuſible ſalt, which can only be decompoſed, by the intromiſſion of the inflammable principle.

§ 84. Thus, the heavier and ſtronger, expels the weaker and lighter acid. Theſe experiments ſhew us, how the more potent acid ſerves to propel the weaker: for, as the acid of nitre ſupplants and propels the acid of ſalt, and as the vitriolic acid propels each of the others; ſo any of theſe mineral acids, propels any of the vegetable acids, that can unaltered bear the operation, from an union with the like baſe. Had the common ſea-ſalt, with its own mineral

alcaline baſe been uſed, the reſult, as to the acids, had been the ſame; but, as to the remaning ſalts, they would have differed: for, from the firſt, the ſaturation of the acid of ſea ſalt, with the native fixed alcali, we ſhould have had true ſea-ſalt; from the diſtillation of that ſalt with the nitrous acid, quadrangular nitre, and from this and the vitriolic acid, Glauber's ſalt.

§ 85. From theſe experiments, the different attractive powers of theſe ſeveral acids to the ſame baſe appear, and the means of breaking their coheſion or union is ſhewn; all to that of the vitriolic acid to the fixed alcali. This is onely to be done by the addition of any phlogiſtic body, and fuſing it with Glauber's ſalt or with vitriolate tartar, and ſome fixed alcali to promote the fuſion of that otherwiſe infuſible ſalt. By this, a ſeparation of the vitriolic or univerſal acid from the alcaline baſe is effected; and a new combination of the univerſal acid with the inflammable principle is produced, which gives ſulphur or common brimſtone, which ſhall be further ſpoken to in giving the method of examining waters. But, this vitriolic acid, the heavieſt and moſt fixed, may be rendered the moſt ſubtil and light of all others, by the union of a certain portion of phlogiſton with it. Thus, vitriol diſtilled in a cracked retort, the acid is ſubtiliſed and volatiliſed. The like is obtained by diſtilling any eſſential oil or ſpirit of wine with oil of vitriol, and by diſtilling pyrites. This kind of acid unites with alcalies and abſorbents, and even with metals for a while; but readily quits them, eſpecially upon the ſlighteſt, increaſed heat, or the interpoſition of an heavier acid. And this is the volatile acid, with which moſt medicated waters are charged, and which is falſely looked upon as a volatile vitriol.

§ 86. 2. As to the alcaline ſalts, it may be neceſſary to give ſome further intimations of their properties, and diſtinguiſhing characteriſtics.

§ 87. As acids are the proper ſolvents of earths and metals, as well as of alcaline ſalts; ſo alcalies break theſe connections, precipitate earths, ſtones, or metals diſſolved in acids, and alſo become the proper ſolvents of mucilages, gums, reſins, gummi-reſins, and oils of vegetables, both the expreſſed and diſtilled, as well as of the fats and oils of animal bodies. On the other hand, by means of alcalies, ſome incomplete, as well as complete, metals are diſſolved; lead, tin, antimony, *&c.* deflagrate with nitre, and are thereby reduced to a calx. In this caſe, the nitre is in part alcaliſed and charged with the metal or metallic. The alcaline ſalts thus charged diſſolve in water; whence, the ſolid contents diſſolve in water, and are precipitated by acids. And copper and iron diſſolved in acids, are wreſted from them and held diſſolved by alcalies.* So likewiſe ſulphur, and various ſulphureous concretes of the mineral kingdom, readily unite with alcalies, and by their means become ſoluble in water, burning ſpirits, and in oils, eſſential and expreſſed.

§ 87. Alcalies likewiſe diſſolve in burning ſpirits, into a kind of ſaponaceous fluid, and give them an orange-colored tincture; eſpecially the fixed, which ſucceed the better the more cauſtic they are rendered by calcination, which they bear with little or no alteration or loſs for a great length of time; unleſs the flame be reverberated upon them, which will in ſome ſort volatiliſe them. Spirits thus charged with alcalies are not to be perfectly freed from them, even by repeted diſtillation. Such are commonly called tartariſed, but properly, are alcaliſed, ſpirits.

§ 88. All the alcalies change the juices of blew and red flowers, and the red juices of certain plants into a green; and the more acrid and pure the alcali, the higher and brighter the green. Blews obtained from certain putrefied plants or vegetable juices, ſuch as

* § 231, 233.

archil,

archil, tournſol, &c. have their colors exalted or preſerved by alcalies, eſpecially the volatile; and when tinged red by acids, alcalies will reſtore them to their priſtine color, or give them a purple or violet hue.

§ 89. Alcalies, readieſt of any ſalts known in a concrete form, diſſolve in water. They may then be taſted, which their extreme acrimony and cauſticity, before ſolution, renders unſafe. They then imprint upon the tongue an urinous, acrid taſte. Such a ſolution is known, 1. by cauſing an ebullition upon mixture with acids, and thereby yielding a neuter ſalt; 2. by changing the colors of certain vegetable juices, as juſt now mentioned *; 3. by precipitating metals and earths diſſolved in acids; 4. by precipitating a ſolution of mercury ſublimate in water, of an orange-color, by the fixed, and of a white, by the volatile, alcalies.

§ 90. The different degrees of ſolubility of ſalts in general, and the manner of ſeparating them from groſſer earths, as well as from each other, ſhall be ſpoken to in ſhewing the diſſolving powers of water.

§ 91. This general ſketch of the generation or production of ſalts, the more ſimple, as acids and alcalies, as well as the more compound, ſuch as the neuter, terrene, and metallic ſalts; together with their relation to each other, and to various other ſubjects; their powers as menſtrua or ſolvents, and their effects in producing, deſtroying, and reſtoring or reviving colors, and in cauſing various precipitations in different ſolutions, ſhall be enlarged and further inſiſted on and explaned, as far as it relates to the preſent purpoſe, in treating of the method of trying or examining waters, to which the reader, for further particulars, is referred.

* § 88.

§ 92. The preceding experiments and obſervations ſhew us, as far as may be expected in a work of this nature, how the various kinds of ſalts are generated, and how the great variety of ſolutions and combinations of bodies capable of being ſuſpended in water, which are by the means of different ſalts found in the univerſe, may be produced and diſcovered.

The End of the general Idea of Salts.

A N

AN ESSAY ON WATERS.

PART I.

Of WATER *in general.*

§ 1. THE element, which the Greeks knew by the name of ὕδωρ, Hudoor, the Latins by that of Aqua; that which the Germans call Waſſer, the French l'Eau, and which in our language is called Water, is a liquor ſo univerſally known, to the rational and irrational animals of the creation, that to the one, the idea is determined by the bare name; to the other, by the ſenſes, upon ſeeing, feeling or taſting.

§ 2. Yet, notwithſtanding this general knowledge of water, nothing ſeems more wanting, or more difficult to be obtained, than a true and rational notion of this moſt beneficent fluid.

§ 3. I ſhall not, in this place, treat of water as a mere element, or one of the phyſical principles or conſtituent parts of other bodies; I ſhall chiefly conſider it as it occurs to our ſenſes, and examine its natural appearances and principal properties, qualities and uſes. And, for better diſtinction, I define it,

§ 4. An humid, fluid, pellucid, colorleſs, inodorous, inſipid body; lighter than earths; heavier than air, moſt * oils and burning ſpirits; incompreſſible; uninflammable; but, by heat, capable of great rarefaction and extreme expanſion, with remarkable elaſticity; and by cold, ſubject to conſolidation in congelation or freeſing. Its conſtituent parts are very heterogene; for, with the ſubtil elementary fluid, pure water, all the other elements, in various forms, as different earths, ſalts, ſulphureous, or inflammable bodies, and air, in greater or ſmaller proportions, and more laxly or intimately blended, are always combined.

§ 5. Though, according to this definition, there be but one kind of water; yet, for greater clearneſs and certainty, we diſtinguiſh it into ſeveral kinds, from the different matters, that appear to predominate in the fluid.

§ 6. Hitherto, there has not been diſcovered, in nature or by art, a water perfectly pure, truly elementary. Yet notwithſtanding, as we are forced to judge of things in general relatively or comparatively, ſo do we judge and ſpeak of waters: ſuch then, as are found to exhibit nothing ſenſible to the ſmell or taſte, and are by all agreed to be clear, colorleſs, inodorous and inſipid, are, by common conſent, called pure or ſweet waters; whileſt ſuch, as ſtrike the ſenſes with ſomething remarkable in color, ſmell or taſte, are called mineral or medicinal waters.

§ 7. But, it is found neceſſary to be ſtill more particular in theſe diſtinctions.

§ 8. The ſcriptural hiſtory of the creation teaches us to divide the waters into two general claſſes. We are there told of the ſeparation of the waters from the waters. Whereby, not only this globe of earth was

* There are ſeveral oils ſpecifically heavier than common water; as the empireumatic oils of guajacum, box, &c. and even the eſſential oils of cloves, cinnamon, ſaſſafras, &c.

copiouſly

copiously furnished with waters, but the heavens, or circumambient air, was so charged with this element, as to be able to render the earth new supplies of purified water upon various emergencies.

§ 9. Thus we find not onely the earth plentifully stored with water, so as to be thence called the terraqueous globe, but the surrounding atmosphere also is every where abundantly charged with this fluid. And these two different deposites or collections hold a continual mutual intercourse with each other, by a sort of distillation.

§ 10. For, the waters of the earth are rarefied, attenuated and divided by the heat of the sun and other fires, into particles specifically lighter than the air; whence they arise in visible vapors or invisible exhalations, and float in the air; until, condensed by colds, they are again returned in form of dew, rain, snow, frost, *&c.*

§ 11. By this means, not onely a continual purification of the waters is carried on, but a perpetual circulation or distribution of them is brought about. The mountains and other high grounds, which, by the ordinary laws of nature, could receive no supplies from the immense collections of water on the face of the earth, are furnished occasionally from the atmosphere. And, when the various terrene productions, that require it, are sufficiently supplied with humidity, the redundance is sent towards the common repository in the conduits of springs and rivers.

§ 12. These considerations naturally teach us to distinguish waters into,

I. Meteoric, or atmospheric; and,
II. Terrestrial.

§ 13. I. The meteoric or atmospheric are onely the humid vapors and exhalations raised from the terraqueous globe, for a while carried about in the air, and by cold condensed into it's pristine form. These are

for

for the moſt part the ſweeteſt and pureſt waters, with which nature furniſhes us. But, as they paſs through the air or atmoſphere, a body as compound, as water can well be imagined, they are never to be looked upon as perfectly pure; they muſt partake of whatever they are capable of diſſolving in the medium, through which they have paſſed.

§ 14. The different kinds of meteoric waters are,

§ 15. 1. Dew: This is a humid vapor raiſed from the earth in the day time, by the heat of the ſun, and as that declines, falling back again upon the ſurface of the globe, and condenſing into water. This is deemed of all others the moſt light and ſubtil water. And, could it be collected at diſtance from great cities, and in receptacles, that could make none impreſſion upon it, it might be accounted the moſt pure of any. But, it varies not onely according to the air, through which it paſſes in its aſcent and deſcent, but is affected alſo by the plants, from which it is gathered. So that it is always difficult to get pure dew. And the pureſt is not to be conſidered, in ſtrictneſs, as pure water. It is very ſubject to fermentation and putrefaction.

§ 16. 2. Rain water: This comes neareſt to dew in levity, ſubtility and purity. It is raiſed from the ſame fund by the ſame means, into the atmoſphere; where it is preſumed to ſojourn longer than dew, which is probably the product of one and the ſame day. Conſequently, rain muſt be more ſtrongly and variouſly impregnated with whatſoever is found capable of floating in the atmoſphere, than dew, which has made a ſhorter circuit. For this reaſon, dew has been but rarely obſerved much altered, except by the body, from which it has been gathered; but, rain has been found charged with every thing, that is by any means ſuſpended in the air. Thus, rain has been obſerved to bring with it various and innumerable products, not onely of the vegetable and animal creation, but alſo of the mineral kingdom; even iron, if we may credit

what

what our Gilbert *, in his treatiſe on the magnete, cites from Avicen, Cardan, Scaliger and Cicero, concerning iron ſhowers; which will appear leſs ſurpriſing, when we come to explane the cauſe of heat in baths. Since rain in its fall muſt waſh the atmoſphere, which is a moſt compound body, always varying with the climate and ſeaſon of the year; it is eaſy to comprehend where and when it is to be had moſt pure. The farther it is collected from cities or other inhabited places, in other words, the clearer and purer the air, where rain is collected, the purer and ſimpler the water muſt be. In like manner, thoſe ſeaſons of the year, in which moſt exhalations ariſe from the earth, are thoſe, in which it is moſt compounded, and ſo *vice verſa*.

§ 17. But, ſo far is the beſt rain water from purity, that it conſtantly ferments and putrefies upon long ſtanding, eſpecially in a warm place. If then diſtilled, it yields an oily, and in ſome meaſure, inflammable ſpirit; which, being concentrated by frequent deſtillations, is ſaid to become a proper ſolvent for gold †.

§ 18. HIPPOCRATES perfers rain to all other waters ‡. He recommends that, which falls from bright white clouds in ſummer; eſpecially after thunder and lightening, by which the air is purified or freed from much ſulphureous matter. He rejects rain, that falls from thick, dark, black clouds. And, in general, recommends the boiling of rain water before it be applied to internal uſe; as it is of all others the moſt liable to corruption. Rain water kept for ſome time, eſpecially in warm weather, ſhews firſt its containing the ſmall ſeeds of various minute plants; which firſt vegetate in it, then render it mucilaginous, and cauſe it to ferment. At the ſame time, it appears charged with the egs of various animalcules, which being

* Phyſ. de Magnete, lib. 1. c. 8.
† Act. Leipſ. an. 1690. p. 86.
‡ Epidem. lib. 6. & De Aquis.

hatched

hatched in it, ſoon after cauſe it to putrefy. Hence the caution of the divine old man is wiſe and juſt.

§ 19. 3. Snow, hail, froſt or ice. Theſe are by moſt diſtinguiſhed from each other; though I cannot ſee with what propriety; ſince they are all but water in different manners and forms congeled, or by cold reduced to more or leſs of a dry and ſolid conſiſtency and form.

§ 20. The pureſt and ligheſt waters are moſt apt to congele or freeze. And all waters, by whatſoever means congeled, are thereby rendered more free from foregne matter of all kinds. Snow and hail may be gathered without being ſenſibly affected by any dry bodies, on which they fall. And ice thawed depoſites ſuch terrene parts, as before adhered to the water.

§ 21. Snow, hail, *&c.* have the ſame origine with rain or dew, and tend to the ſame end. The humid vapors and exhalations riſing from the earth, which are but water ſo rarefied and divided, as to be made capable of floating, or being ſuſpended in the air; by one degree of cold, are rendered ſpecifically heavier than the air, in which they were but juſt now ſuſpended; whence, they neceſſarily preponderate; but in thoſe minute and almoſt imperceptible particles, which are called dew. Such of theſe vapors, *&c.* as are raiſed higher, in the region of the air, are carried about according as the air is put in motion; until, by a certain degree of cold, they are again condenſed into water, and ſo deſtil in rain. And an higher degree of cold converts this into a dry conſiſtency, and lets it fall in the different forms of ſnow, hail, *&c.* Froſt is to ſnow or hail, as dew is to rain.

§ 22. Theſe are the various meteoric waters known. To theſe, the fertility of the earth is owing; as they furniſh it, not only with that humidity, which is neceſſary for all its products, but with ſalts and other ſubſtances, that promote vegetation. From theſe, our fountanes and rivers derive their origine: for, after they have furniſhed the ſurface of the earth with what they

they contain or convey, they ſink into its bowels, form for themſelves various canals and aqueducts under ground; until, in ſome depending part, they break through their bounds and burſt forth in the form of a ſpring, with force proportioned to the heighth from whence it falls, and greater or ſmaller in proportion to the fund that ſupplies its courſe.

§ 23. However, we are not to ſuppoſe, that every ſpring gives back its water pure, as it received it from the clouds: for, as in the air, it was liable to be diverſly impregnated; ſo is it alſo in the earth; where it ſuffers various changes, according as thoſe parts, through which it paſſes, contain more or leſs of matters ſoluble in water. Were it not for this, every ſpring would yield up its water unaltered from what it received it from the heavens: of which very few inſtances are known.

§ 24. Snow water, by the antients, was deemed unwholeſom. And many of the moderns aſcribe the bronchocele or preternatural ſwelling of the thyroide and other glands about the throat, a diſtemper obſerved endemial in ſome parts of Switzerland, to the drinking waters, ariſing from the ſnow thawed in the mountains. But, this appears to be abſurd upon the examining of ſnow water, which is found as pure, as any other, if not purer. Moreover, this diſtemper is obſervable in many other countries, where ſnow contributes but little to the increaſe of their waters. At Rheims, the capital of Champagne in France, there is hardly an aged perſon free from this diſorder; which is owing to their drinking, till lately, that they have been ſupplied with better, the common water of their wells, which runs through a kind of chalky quarry, with which it is ſtrongly charged. I have obſerved the ſame from the abuſe of Spa water; for a reaſon, which ſhall be aſſigned in its place. And a further vindication of ſnow water from this offenſive quality may be taken from the famous Pfeffer waters in Switzerland. Theſe ſprings flow periodically. They

begin

begin in May, and ceaſe, ſo as to be quite dry in September; and this regularly, ſomewhat ſooner or later, every year. Theſe waters, at the ſprings, are warm. And are the lighteſt, pureſt, ſimpleſt water to us known on earth. Yet, they muſt certainly owe their origine to ſnows, which begin to thaw in May, and continue to run till the beginning of September, when the returning cold congeles them and ſtops their current, till the next enſuing ſpring.

§ 25. II. The terreſtrial waters are thoſe, that are found in the bowels or upon the ſurface of the earth. Theſe are always to be preſumed more groſs, heavy and impure, than the meteoric. They are divided into two ſpecial claſſes: 1. Simple or ſweet, rather inſipid waters: 2. More compound and ſapid, mineral or medicated waters. Of thoſe here, of theſe in the ſecond part.

§ 26. The firſt are diſtinguiſhed into, 1. Springs; 2. Wells; 3. Rivers; 4. Lakes; 5. Stagnant waters.

§ 27. 1. Spring or fountane water. This takes its riſe from meteoric water, condenſed or collected on the neighbouring high grounds, and by its frame and gravity entering into the earth, and forming to itſelf fit canals to convey it to ſome place, where it may lie upon a level and at reſt. That ſprings conſiſt of waters, which were ſometime on the ſurface of the earth, is evident from divers conſideration; particularly their frequently carrying with them bodies onely produced on the ſurface of the earth. As at Bath, hazel nutſhells and entire nuts are thrown up by the waters. Beſides, the ſenſible increaſe and decreaſe of ſome, eſpecially the more ſuperficial ſprings, after wet and dry weather, planely ſhews whence they muſt have derived their ſources. Add to this, that in Ægypt, in the Deſerts of Æthiopia and Arabia, in Fierro, one of the Canary Iſlands, and other countries, where neither ſnow, hail or rain are ſeen, they have no fountanes, nor rivers, that ſpring up in them; whileſt Germany,

France,

France, Britain, Ireland, and other nations ſubject to ſnows and rain, abound in living ſprings, rivers and lakes.

§ 28. Next to rain water, that of ſprings is reckoned the moſt pure. However, it is liable to infinite variation, according to the nature of the ſoils, through which it runs: it is more or leſs ſimple according to the ſolubility or inſolubility of the matters, it meets in its paſſage through the bowels of the earth, and according to its proximity to, or remoteneſs from, its ſource.

§ 29. That ſpring is beſt, which runs from a ſteep, rocky, ſtoney or gravelly ſoil, with a quick, ſmart current. Whoſe water is moſt pellucid, and moſt void of all ſenſible ſmell and taſte; moſt readily heated, and moſt ſuddenly cooled, and leaves the leaſt ſediment after boiling, evaporation, or upon ſtanding.

§ 30. The antients, after HIPPOCRATES *, had reſpect to the aſpect of the ſpring, as whether it lay expoſed or run toward the eaſt or weſt, ſouth or north. They preferred the firſt, as ſuffering the leaſt changes from the ſun. Next to that, they eſteemed the ſecond for the like cauſe. They rejected the third, as being liable to be heated and to have the moſt ſubtil parts diſſipated or exhaled by the ſun. And the fourth, they condemned, as crude from its coldneſs, and hard of digeſtion. Theſe reaſons may have their force in the countries in which the fathers of phyſic lived and wrote; but, in our temperate climate, which never feels the extremes of heat or cold, they can be but of very little weight. We are chiefly to conſider the nature of the ſoil around the ſpring, from whoſe ſurface, by collecting the falling rains and ſnows, its origine may be deduced, and the ſoil through which it runs, and the quickneſs or ſlowneſs of its progreſs.

§ 31. In order to make a moſt judicious choice of waters, we ſhould diſtinguiſh ſprings, not only from

* De Aere Locis & Aquis.

their

their ſituation and ſoil, but according to their courſes, whether temporary or conſtant, annual or perrennial; ſtagnant or ſlow-running, quick or flowing ſprings.

§ 32. The temporary ſprings are either uncertain, depending upon the falls of rain or ſnow in all ſeaſons of the year; or periodical or annual, which, from the ſame cauſes, begin to flow in September or October, and continue till April or May. Theſe may be called ſuperficial ſprings. They have no reſervoir or conſiderable receptacle in the bowels of the earth, from which their waters may flow onely in certain determinate quantities; they deliver them, as faſt as they receive them from the clouds or condenſing hills, and for the moſt part, as unchanged. Of theſe, there are great numbers obſervable in almoſt all countries. The moſt conſiderable, that I have ſeen, eſpecially of the latter kind, are in the counties of Clare and Galway, in the kingdom of Ireland; where large tracts of ſome hundreds of acres, of the beſt and ſweeteſt paſturage, are every winter over-whelmed with an inundation, that ſprings up in different parts of the ſoil, clear, pellucid, and almoſt as ſimple, as it fell from the heavens. Theſe can be none other waters, than the meteoric: they fall in the rockey mountains, to whoſe hollow entrails they find eaſy acceſs, and from which they have as free an egreſs; for, being chiefly compoſed of ſtone, without any interpoſition of earth or ſand, and lying ſhelving, the waters cannot tarry long in their paſſage, but muſt precipitately run towards the plane, level grounds, that lie ready to receive them. And, as the ſtones, they waſh, are ſolid lime-ſtone or marble, which, without calcination, are not to be affected by ſimple water; it is not to be wondered, that the waters of theſe temporary or annual ſprings in theſe and ſuch like ſoils, ſhould be of all others the moſt pure. But, were theſe waters, in their falling through the air or their paſſage through the earth, charged with any acid, the caſe would then be different; for as theſe ſtones are ſoluble in acids, hard or petrifying

waters

waters would have been produced. However, when theſe like ſprings ceaſe to flow, they ſoon change their nature, as all ſtagnant waters muſt. The flower all ſprings flow, the more charged they may be preſumed to be, and the nearer they approach to the qualities of ſtagnant water. Therefore, the quick, flowing ſpring is to be prefered.

§ 33. The conſtant or perennial ſpring, is that whoſe waters have, from the ſurface, ſunk deep into the bowels of the earth; there, formed to themſelves reſervoirs or repoſitories, where they lie unaffected by the air, and from whence, by paſſages of certain dimenſions, they are delivered conſtantly in the ſame proportionate and uniform current, and of a like temperament in hot and cold, wet and dry ſeaſons. The general notion, that ſprings are colder in ſummer and warmer in winter, is but a vulgar error: they appear ſo to the touch, it is true; becauſe the human, and every other animal, body is hotter in ſummer, than in winter. Such things, as we pronounce cold upon the touch, when we are heated, we ſhould pronounce warm or leſs cold, when we are cooled: and this is the cauſe of this long prevaling miſtake.

§ 34. The ſprings, in a more ſtrict ſenſe, called periodical, are ſuch as flow for a certain determinate number of days, hours, or minutes, and ceaſe for a known time. Of this kind, divers are mentioned by travellers. As one in Judaea, that flows for ſix days, and reſts or ceaſes on the ſeventh; whence, it is called Sabbatticus, the Sabbath, or Sunday ſpring. Some in Sweden and Switzerland, that flow once or twice in the day, and ſome that flow and ceaſe ſeveral times, ſix or eight times, for inſtance, in an hour. I have heared of ſome of this kind in Britain and Ireland; particularly one at Giggleſwick, in Yorkſhire; another, called Lay-well, near Torbay in Devonſhire; but never ſaw any. Various extraordinary conjectures have been made to account for the production of this ſort of ſpring. But, I am of opinion, that whoever-

has seen a chemist's first separating funnel, used for the parting of essential oils from distilled waters, a siphon or crane for drawing liquors from one vessel into another, or remembers the draining the Serpentine-river in Hyde-park some years ago, by a drain made in a crane-formed canal, with intent to carry off redundant water onely; which, as soon as a flood fell, that raised the water above the bending of the canal, necessarily emptied the river to the level of the shortest leg of the siphon; whoever, I say, considers these natural operations, can not be at a loss to conceive how similar canals may be formed in the earth; how they should communicate with basons or springs of water, and discharge them at different periods, proportioned to the fund of water and the diameter of the tube or aperture. And this, I apprehend, will give a more rational solution of the phaenomenon, than having recourse to a distillation by a central or other subterranean fire, or to the flux or reflux of the sea; to which too many have trusted in vane.

§ 35. 2. Well or pump-water approaches nearest to that of springs or fountanes. They all derive their origin from the same common source. They differ in this, that the later, by nature, spring forth and flow on the surface of the earth; the former are sought where springs, by the ordinary laws of nature, could not flow spontaneous; and are therefore sunk or dug for, till the spring or reservoir of water be layed open, to be afterwards drawn out by pumps or other convenient machines. These waters differ but accidentally from those of springs. They are often more charged and hard, than those of flowing springs are generally found. Then, for want of frequent drawing or pumping, they put on the nature of stagnant waters. Otherwise, they agree with springs.

§ 36. 3. Rivers, and 4. Lakes, derive their waters from springs; but, vary from them by divers accidents; such as being longer exposed to the sun and air; receiving many drains and rivulets from the sur-

face

face of the earth, in various places; in the length of their courſes, running over a greater variety of ſoils; receiving ſeveral putrid bodies, vegetable and animal, as well as being the habitation of a great part of the animal creation; all which muſt neceſſarily render theſe waters more compound, than ſprings.

§ 37. Rivers, that take riſe in the higheſt mountanes, and run moſt rapid, like the quickeſt ſprings, are generally the pureſt water. Thus, the Rhine and the Rhoſne, which flow from the Rhetian Alpes, while they preſerve their rapid courſes, are found moſt pure and light. The difference betwixt the Rhine and the Maine, is perceptible to thoſe, that navigate theſe rivers, who find the barges and other loaded veſſels, that ſail from the later into the former, ſink conſiderably deeper in the one, than the other. Thus, rivers differ from each other, as much as ſprings. It is not ſolely the rapidity of the courſe or ſpring of either, that cauſes their waters to be pure and clear. The ſoil through which they paſs, muſt contribute its part; if it be gravelly or ſtoney, the water will be clear; if clayie or loamy, it will be foul and muddy. Thus, we ſee the Seine in France, whoſe courſe is not deemed much leſs precipitate, than that of the Rhine, is foul and turbid, as the Avon below Briſtol, or as any troubled, ſtagnant water; whileſt our Thames, gliding with a much gentler motion over her ſtoney, flinty, gravelly or ſandy bottom, preſerves her purity and pellucidity, until ſhe is tainted with an infinite variety of adventitious bodies from the ſtreets and ſewers of our capital, as well as from the ſcarce numerable ſhips and other veſſels, that reſort her port. River waters being expoſed to the open air, contain every thing, that rain does; and, like that, ferment and putrefy, grow foul, yield alike a fetid vapor, which is inflammable. And as ſoon as this eſcapes, the terrene parts ſubſide, and the water becomes pure and ſweet again.

§ 38. Lakes are, for the moſt part, but expanſions of rivers, and therefore generally partake of their quality and nature. Some are ſeen without any river running into or from them. Theſe are to be conſidered, as a kind of ſtagnant or ſlow-flowing ſprings. It is moſt probable, they have their diſcharges, as well as their ſources, below their ſurfaces, and therefore, inviſible. Some of theſe, as well as the greater, are obſerved, about Switzerland and the Alpes, to have a ſeeming flux and reflux, like the ſea; but, at different periods, and from very different cauſes; the one depending upon the preſence and abſence of the ſun, as the other on the place and changes of the moon. The lakes, as well as ſprings, that owe their riſe to ſnow, increaſe as the ſnow thaws with the heat of the ſun; and from ſun-ſet to ſun-riſe, ebb or ſenſibly decreaſe. This is obſerved in the lake of Geneva, and ſome others.

§ 39. 5. Next to the waters of lakes, the ſtagnant waters of ponds, pools, &c. are to be conſidered. Theſe vary according to the air, ſeaſon, and ſoil in which they ſtand, as well as from the ſource, whence they draw their ſupplies. They are at all times liable to be contaminated with an infinite variety of foregne and foul matters; and in ſummer, with a great variety of ſmall capillary plants, and with living animals numberleſs. Hence, they are always foul, heavy, muddy, and ill-taſted; in the hotter weather, ill-ſmelling and putrid. Conſequently, of all others, the moſt unfit and unwholſom for the uſes of man and beaſt. The bare exhalations of theſe waters infect the air. Whence, all countries, where ſtagnant waters abound, muſt be unhealthful. Such are found the fens of Eſſex, Lincolnſhire, *&c.* the Campania of Rome, and the like.

Of the nature and properties of ſimple water.

§ 40. AS water is moſt indiſpenſably neceſſary for innumerable uſes and purpoſes in the oeconomy of life, it becomes one of the moſt intereſting ſubjects, and the beſt deſeving the attention of all ranks of men, from philoſophers and phyſicians to ruſtics and mechanics.

§ 41. As it is eſſentially neceſſary in the production or ſuſtenance of every part of the creation, reaſon, as well as religion, demands our aſſent to the ſcriptural hiſtory of water, which informs us, that this was the firſt formed element; that part of the terreſtial creation, which was firſt finiſhed by the Almighty's all-creative hand; * A proof that it was intended, by infinite power and wiſdom, as a principal ingredient, or a material inſtrument, in his future works. And this, upon examination, water will be found.

§ 42. Many have been at immenſe pains and labor, to acquire ſome knowledge of the eſſential or conſtituent parts of water; but, they have labored to ſo little purpoſe, that the utmoſt, that has hitherto been learned from all their attempts, is ſome notion of its properties and effects; whence, the definition before given has been drawn.

§ 43. Water has been, by many of the antients, looked upon, as the material principle of all natural bodies; whence it, with ſome, acquired the pompous appellation of Omniſeminaria, the univerſal ſeminary of all material beings. Several of the moderns embraced the ſame opinion. † Whileſt ſome ſuſtain, that the Chaos, mentioned in the ſacred and prophane hiſtories of the creation, was a maſs of a certain kind of viſcous or mucous water, which, by the omnipotent will of the

* Gen. chap. i. † Bohn. in diſſertat. chym. phyſ. Le Mort. in chym. med. phyſ.

author of nature, in the ſcriptures ſtiled the Spirit of God moving upon the waters, ſeparated the waters from the waters; that is, parted this rude maſs into three diſtinct ſpecies of this fluid, or reduced it into three different conſiſtencies or forms; the firſt, and moſt ſubtil of which, is air; the ſecond, the leſs ſubtil or middle ſtate, what we commonly call, and know by the name of, water; the third, or more groſs and heavy, earth of various kinds.* This poſition, which at firſt ſight appears ſomewhat extravagant, will appear more familiar when we come to examine the nature of water more ſtrictly, where the near relation, the intimate and inſeparable connection of theſe three elements, will be made moſt evident; it being hard to find air without water; as it is well known, that water is convertible into, or miſcible with, air; and that there is no water found free from air and earth.

§ 44. Others, inſtead of conſidering earth, as a kind of water, have looked upon water, as a ſort of terrene body, a liquid or fluid earth. After various diſquiſitions upon this head, it became a queſtion, how, and in what, water differed eſſentially from earth? As it alſo did, whether water was not convertible into earth, and earth into water?

§ 45. Theſe, the peripatetics peremptorily oppoſed; holding water and earth to be diſtinct eſſences, two of their four principles or elements of natural bodies, fire, air, water, and earth. With theſe, the patron of itinerant empyrics and ſecret-mongers, Paracelſus, implicitly joined. His obſcure aſſertions can add but little weight to the notions of his party, when he offers neither reaſon nor experiment to ſupport the aſſertion. Whilſt Van Helmont and Becher oppoſe them, and offer ſpecious arguments drawn from experiments and obſervations to ſupport the affirmative; to wit, that water is none other than liquid earth.

* D. Helbig. in introitu in phyſ. veram & inaudit.

§ 46. The

§ 46. The proofs, they offer of this notion, are drawn from the following conſiderations;

§ 47. 1. In order to ſet theſe arguments in the moſt diſtinct light, we muſt here firſt obſerve, that certain philoſophers have placed the eſſence of water in a moſt minute globular form of its parts; others, in a very fine, ſmooth, ſerpentine conformation of its particles; whence, they are pleaſed to ſuppoſe its humidity, fluidity, volatility, or aptneſs to evaporate and mix with the air, are derived.

§ 48. But, a cloſer and clearer method of enquiry and reaſoning has taught us, that, however the form of the particles of water may approach to the globular or ſerpentine, its humidity, fluidity, volatility, &c. will be found to depend upon other, and theſe moſt different, cauſes; to wit, extreme tenuity of parts, and external, adventitious heat; not upon theſe imaginary configurations of parts alone. The different heat or cold of water is owing to outward accidents. In certain degrees of heat, to wit, in thirty three of Fahrenheit's thermometer, and upwards, water is always fluid. Whereas, in thirty two degrees of the ſame machine, and under, it is quite the reverſe, ſolid. It is then owing to this degree of heat, which is outward, adventitious or accidental, that water preſerves the principal properties in our definition; ſince, by a deprivation of this heat ſolely, that is, by cold alone, all theſe properties are abſolutely deſtroyed, and the humid, fluid, volatile ſubſtance becomes an hard, ſolid, dry, and in appearance, terrene body. And, on the contrary, by reſtoring the loſſed degree of heat, humidity, fluidity, and other properties are reſtored to the water.

§ 49. Hence, it is plane, we have no competent evidence of the determinate form of the eſſential particles of which water is compoſed, more than of thoſe, of which divers other bodies are formed. We may ſhew the common chemical principles of ſome bodies, in their effects upon certain mixed and compound bodies; but, we muſt have more acute ſenſes, than are

allowed to mere mortals, to behold the ſpecific or eſſential form of the phyſical elements of matter. Wherefore, it is not ſurpriſing, that we have not hitherto been able to aſcertain the proportion, theſe particles bear to others, or the mutual correſpondence in conformation or configuration of parts, that makes ſaline, mucilaginous, gelatinous or gummy, and ſuch like ſubjects intimately mix, and cloſely cohere with this fluid; in other words, that renders this the fit ſolvent for theſe like bodies.

§ 50. This quality of water, its fluidity and ſolidity depending alike on external accidents, is one of the arguments to ſuſtain the opinion of Van Helmont and Becher: For, they judge it probable, that if by any means the particles heavier than water, which cauſed its ſolidity or congelation, could be confined in the water, it muſt retain the ſolid and terrene form, it by theſe means puts on.

§ 51. 2. Theſe notions ſeem favored by ſome experiments cited from Glauber and others. By which it appears, that water, by the addition of a certain quantity of divers dry bodies, may be reduced to a conſiſtent, ſolid form.

§ 52. Thus, we ſee various, earths, which, void of humidity, are but looſe, light, and incoherent duſt; by the addition of water, become conſiſtent and tenacious; and being baked in a proper heat, are rendered ſolid and hard as ſtone. Such are bricks, tiles, and all ſorts of earthen ware.

§ 53. Thus alſo, lime and ſand, with a certain portion of water, puts on a ſtony hardneſs. As does gypſum or plaſter of Paris calcined.

§ 54. The ſame may be ſayed likewiſe of Glauber's ſalt, in ſome ſenſe. This, like other cryſtalliſed ſalts, owes its pellucid and cryſtalline form, as well as much of its weight, to water. This water being exhaled, by expoſing this ſalt to a warmer air, it loſes its pellucidity and becomes a white powder. Upon adding to this a certain quantity of water, it puts on an icy ſolidity.

§ 55. 3. To these, they add the intimate union, or close connexion of water with various solids. As for example; the neuter salt, composed of a fixed alcaline salt and the vitriolic acid, from its being made with salt of tartar and oil of vitriol, called tartar vitriolate; this salt, when dried, is able to withstand the force of an ordinary fusing heat, without fluxing or flying off. Yet, dissolved in water, and evaporated in an heat equal to that of boiling water, will lose considerably of its weight. Most other like salts are observed to suffer great waste by this treatment. Whence, the most judicious chemists use the slowest heat in their evaporations, whether for crystallisation or reducing their salts to dryness.

§ 56. 4. Not very different from this, is the loss which lime-water is sayed, by these and other authors, to sustain in evaporation.* By calcination of the lime-stone, of marbles, and the shells of fishes, their nature is so far altered, that a considerable portion of them becomes soluble in common water. Lime-water is prepared by infusing unslaked lime or roche-lime in water. A salt-like pellicle constantly covers the surface of this water, and by its gravity, precipitations with various salts and metalic solutions, by its dissolving sulphur, &c. it gives manifest proof of its being strongly impregnated with the lime-stone, by calcination reduced to an acrid, alcaline, pure earth. Yet, these stoney, or rather now terrene, particles, capable before of resisting the utmost torture of fire, thus dissolved in water, adhere so closely to it, according to these writers, as to fly off entirely with it in evaporation. But, more accurate experiments shew this to be very fallacious: Though lime be thus soluble; yet, water may not be charged with it, more than with salts, above a certain proportion. The portion then, it takes, is at best but small; and therefore, there can be but little left after evaporation. But, there appears no

* HOFFMAN obsev. phys. chem. lib. ii. obs. 19.

room

room to doubt of whatever the water contains, remaning after evaporation.

§ 57. 5. Theſe notions, however, ſeem to receive further confirmation from the experiments of BORRICHIUS the learned Dane, Van HELMONT the younger, and our BOYLE, with ſeveral others, who affirm, that earth may and has been ſeparated from water, after one, yea, two hundred diſtillations. This fine, ſand-like earth, which remanes after diſtillation, Van HELMONT will have to be the firſt principle of water. But, this deſerves further and nicer diſquiſition. Let us now come to the proof of our definition, in which this matter will again fall under conſideration; onely tranſiently obſerving, that ſince water is found to have ſuch affinity to earth, and ſince we can trace it in no part of the creation, where it comes not into contact with great variety of terrene, ſaline, and ſalino-ſulphureous bodies, it is not to be wondered, that we never ſee in nature, nor can procure by art, water perfectly pure.

§ 58. The firſt diſtinguiſhing characteriſtics of water, are humidity and fluidity, or humido-fluidity. By humidity is meaned that property of water, by which it adheres, upon contact, to certain bodies, and humects, moiſtens or wets them. Thus, it moiſtens or wets all ſtones, earths, glaſs, metals, woods, &c. This property is owing to the extreme tenuity of its parts, which renders them capable of being moſt eaſily ſeparated and divided, and of adhering to ſuch bodies, as come into contact with them, with which they have any attraction; ſuch are thoſe above mentioned. By ſundry other bodies, water is repelled; ſuch are all fat, oily, and reſinous bodies. By its general humecting quality, water is diſtinguiſhed from aqua philoſophorum, the philoſopher's water; aqua ſicca, dry water; and humor radicalis metallorum, the radical moiſture of metals; which mercury or quickſilver is deemed by the chemiſts: For, this attracts, humects, or adheres to no bodies, but certain metals, to which it is ſuppoſed

poſed to miniſter the office, and bear that affinity, which water does to vegetables and animals.

§ 59. Inſeparable from this quality, is that of fluidity; whence, they may properly be united under the term, humido-fluidity. Fluidity is a property, which water holds in common with all other liquors, as it is likewiſe diſtinguiſhed from mercury, by that of humidity. The fluidity of water depends upon two cauſes, the firſt is the extreme ſubtility, or tenuity, of its elementary or component particles; the ſecond, a certain degree of heat, actual fire; without which water, agreeable to our definition, to wit, in a liquid ſtate, is never found.

§. 60. It is impoſſible for finite capacities to meaſure, or even to comprehend, the ſize or form of an elementary particle of water, more than thoſe of other bodies. By experiments and obſervations, we find theſe particles are inconceivably minute, and of a form the fitteſt to paſs through the fineſt tubes or pores imaginable. All animals, as well as vegetables, receive their nutrition and accretion by pores inconceivably ſmall. We daily obſerve ſeveral plants, ſet in water, receiving nouriſhment a while without roots, afterwards ſtriking roots in the water, growing and flouriſhing therein. We ſee variety of other plants live and grow, without receiving any apparent humidity at the roots. This may be obſerved, not only in ſundry ſmall plants, but in ivy, and ſeveral ſhrubs and trees flouriſhing, on arid rocks, old walls, *&c.* But, in many of the ſucculent tribe of aloes and ficoides, this is ſtill more evident; for, ſome of theſe increaſe in bulk and weight, without any root at all. This certainly could not be, unleſs water had free acceſs by the inviſible pores of theſe vegetables, which the particles of elaſtic air are incapable of entering. To this, the conformation of the parts muſt certainly contribute: a ſpherical or globular particle might paſs, where a cube or any other figure, though of equal dimenſions, would be denied admiſſion. But, no figure could poſſibly render

render any particle capable of paſſing through a tube, or pore, of ſmaller dimenſions. Therefore, ſuch particles, as may paſs through perforations, ſo extremely minute, as to eſcape our ſenſes, ſuch as the inſorbent pores of vegetables and animals, muſt neceſſarily be exceſſively ſmall. And ſuch therefore, are the particles of water.

§ 61. From this extreme tenuity of parts, it is eaſy to conceive how water becomes fluid: it is kept in this ſtate, by whatſoever divides or breaks the coheſion of theſe fine parts, and keeps them in motion. This is done by fire. There is no water, in a fluid ſtate, without fire. The degree of fire neceſſary to keep water fluid, is aſcertained by the thermometer. Water kept any where, or at any time, where the mercury falls below thirty three degrees of Fahrenheit's thermometer, will, in a certain ſpace of time, loſe its fluidity, and become a perfect ſolid; to wit, ice. Wherever the mercury riſes in this machine to thirty three degrees or upwards, there the water will be found in the utmoſt fluidity of which it is capable, as far as can be meaſured by human ſenſes or experiments; for, though higher degrees of heat rarefy and expand water, that is, make the ſame quantity of water occupy a greater ſpace, and therefore appear relatively lighter, in proportion as it is heated from the thirty third degree to the two hundred and twelveth or thirteenth, in which it boils; yet, have we not hitherto diſcovered any means of meaſuring the different degrees of fluidity. The pendulum was the method by which Sir ISAAC NEWTON compared the fluidity of hot water to that of cold, and he found the vibrations in both alike. But, this experiment is inſufficient; as no pendulum has been yet diſcovered, that does not expand with heat, as it contracts with cold. And thus, for want of fit machines, this queſtion muſt yet remane undetermined to our ſatisfaction. The beſt proof, that can at preſent be offered, to ſhew, that the fluidity of water cold and hot is nearly the ſame, may be taken from this conſideration; to wit, that whatſoever veſſel is capa-

ble

ble of containing cold water, is alſo capable of holding hot. This is apparent in pots and kettles, in diſtilling veſſels, in Papin's digeſter, and in the aeolipile: for, as the water does not paſs through theſe or ſuch like veſſels when cold, no more is it capable of paſſing when heated; which, if it were then more fluid, it muſt.

§ 62. To this extreme tenuity of the parts of water, the eaſy rendering it fluid, as well as of diſſipating it in inviſible vapors in the air, are owing. The more minute the particles, the eaſier they are put in motion, the eaſier of courſe they are kept fluid, the eaſier they recede from each other. Thus water, by the ſame degree of heat, that is ſufficient to preſerve the character of fluidity, is divided, diſſipated, or exhaled: for, while it is fluid, it muſt be in motion, and in its motion, ſome parts muſt evaporate or exhale. Thus, we ſee cloaths dry, rivers, lakes, and ponds evidently diminiſh, in very cold weather, as well as in hot, without emitting any viſible vapor. This ſhews the extreme mobility and diviſibility of water; which, the purer it is, the leſs its coheſion, the eaſier it is ſet in motion and diſſipated. This is proved further in the diſtillation of water: The ſimpleſt is moſt eaſily and readily heated, conſequently diſtils the ſooneſt. And, in diſtillation, the parts of water do not cohere like thoſe of oily, ſpirituous, or ſaline liquors, which being raiſed in a warm vapor by heat, and ſtriking againſt the internal ſurface of the glaſs alembic or retort, are condenſed by the external cold of the air, and diſtinguiſh themſelves by running along the glaſs in little vene-like ſtreams or rivulets, and ſo diſtil into the recipient; whileſt water, in the natural ſtate, pure and unaltered by fermentation or putrefaction, being by fire converted into a warm vapor, upon ſtriking againſt the internal ſurface of the diſtilling veſſels, is condenſed in form of a dewy moiſture, and as the drops increaſe in ſize and weight, trickle, or diſtil, in that form, into the receiver. Hence, as freſh water is more eaſily ſet in motion than ſalt, there muſt

be a greater exhalation, in proportion, from ſprings, rivers, lakes, and other freſh waters, than from the ſea. This is exactly calculated by that very learned and ingenious philoſopher, the reverend Dr. HALES.*

§ 63. The next characteriſtics of water, ſet forth in our definition, its being pellucid, colorleſs, inodorous and inſipid, are ſo apparent to the ſenſes, that they need no further diſquiſition to prove them. Various bodies are found in divers waters, which diminiſh or obſtruct their pellucidity, give them a color, ſmell, and taſte; but, ſuch make none eſſential part of the water, and are to be looked upon as foregne and adventitious. The nearer any water comes to this part of our definition, the purer it is; as on the other hand, the further it recedes from this character, the more foul and impure or compound will it ever be found.

§ 64. Water is lighter than earths, properly ſo called: theſe are not ſoluble in ſimple water. And though reduced to the utmoſt tenuity by trituration or grinding, they are incapable of being long ſuſpended in water; but, muſt by their ſuperior gravity preponderate and ſubſide; unleſs they be firſt diſſolved in ſome proper ſolvent; in which caſe, the parts of theſe ſolids being by diſſolution ſo minutely divided, as to be reduced to a fluid ſtate, are then made capable of mixing with and being ſuſpended in water.

§ 65. Water, in which any terrene ſubſtance is onely mixed, appears muddy and foul, but will fine, by the ſubſidence of the ſolid parts, upon ſtanding. Such a water may then be ſoft and pure. But, water, in which the terrene parts are by any means diſſolved, muſt be always hard, and heavier, than pure water, in proportion, as it is charged with ſuch foregne matter. Hence, the cleaneſt and lighteſt water is the pureſt, ſimpleſt, and beſt, for ordinary purpoſes.

§ 66. As earth is heavier than water, ſo is water heavier than air. Water reſolved into vapor, is ſo light, as to be then capable of floating a while in the

* See Philoſ. Tranſ. No. 189. p. 366.

air;

air; but, as ſoon, as it is by any means condenſed, it preponderates in its original form: thus, dew and rain are produced, and thus is diſtillation performed; or, if the medium through which the aqueous vapor or exhalation paſſes in its condenſation be cold enough, to wit, of thirty two degrees of Fahrenheit's thermometer or under, it will then deſcend in a ſolid form; that of ſnow, hail, or froſt.

§ 67. Water is not onely heavier, than that ſubtil, natural fluid, air; but, it is alſo found heavier, than divers artificial liquors; ſuch as moſt oils; not onely thoſe obtained by diſtillation from aromatic vegetables, which are very light and ſubtil for the moſt part; but thoſe obtained by boiling or expreſſing divers parts of vegetables, as well as animals; though ſuch be groſs, mucilaginous, and viſcid. Hence, all theſe like bodies never unite with water; but, being mixed therewith by agitation, ſoon ſeparate from it, by a certain diſſimilarity in the make and conſtituent parts of each; whence ſimilar, or like attract like; whileſt diſſimilar or unlike repel each other: for, the particles of oil ſeparated by the interpoſition of the water, ſoon after, attract each other; repelling or rejecting the water, whoſe parts, at the ſame time, attract each other and repel thoſe of the oil, unite in globules, ariſe and float upon the water. However, to the later part of this general rule, there is an exception: for, not onely the groſs empyreumatic or aduſt oils of guajacum, box, *&c.* but the eſſential oils of cinnamon, cloves, ſaſſafras, *&c.* are found heavier than water. None oily or ſulphureous bodies, as is hence evident, are ſoluble in pure water; no more are the fat of animals, the balſams or reſins of vegetables, nor the various bitumens or foſſil oils, balſams, or reſins, that are found in various countries in the bowels of the earth. With theſe, common brimſtone may be enumerated: for, none of theſe are ever found diſſolved in water, by nature or art; without the interpoſition of ſome proper ſalt, capable of diſſolving them, or ſome viſcous

ſubſtance

ſubſtance capable of intangling them, as ſhall be further explained in treating of the different medicated waters.

§ 68. When water is found heavier, than moſt eſſential oils, it will not be thought ſtrange, that it ſhould be heavier, than burning ſpirits, which are oils attenuated and ſubtiliſed by the action of fermentation, and united with a certain portion of water. This water is inſeparable from burning ſpirits; and this it is, that makes the moſt dephlegmated or rectified ſpirit readily mix with other waters, which the oils are found incapable of doing, for want of ſuch a proportion. However, though rectified ſpirit and water readily mix and intimately unite; yet, if water be, by a funnel, conveyed to the bottom of ſuch ſpirit, or the ſpirit be poured gradually upon the ſurface of water; each will keep its reſpective place, till by motion they are mixed. Then, they can be ſeparated onely by fire, which in diſtillation raiſes the lighteſt body, the ſpirit, firſt; or by the interpoſition of ſuch bodies, as have a greater affinity or ſtronger attraction to the one, than the other; thus, the mixture being charged with fixed alcaline ſalts, as far as it is capable, the ſalts and water attract each other moſt ſtrongly, fall to the bottom, and ſet the ſpirit free. In like manner, the mixture of ſpirit and water, being expoſed to a freeſing cold, thirty-two degrees by the thermometer, the cold will deprive the water of its liquidity, and reduce it to ſolid ice; while it leaves the ſpirit free and fluid.

§ 69. We are now to conſider the incompreſſibility of water. We cannot with certainty demonſtrate the conſiſtency, more than we can the form and ſize, of the conſtituent particles of water. From their immutability, it is preſumed they are extremely hard and conſequently unalterable in their nature: for, water rarefied by fire into a vapor ſubtil and elaſtic as air, may be condenſed into water again, with all the properties and characteriſtics, it poſſeſſed before this change. And water, by cold condenſed into a ſolid, may be reduced again to a fluid ſtate, as is ice, by thawing

thawing with heat, and appears then of the ſame humidity, fluidity, gravity and other qualities, as before this change; which, certainly, could not have been, had the nature or form of the particles been eſſentially altered. From this extreme hardneſs of the parts, we may preſume, the incompreſſibility of water ariſes. This would appear upon every experiment more evident, could water be found free of that elaſtic, compreſſible fluid, air. But, this may not be: for, water, however conſtructed, muſt have pores, and theſe pores, like thoſe of other bodies, muſt be filled with particles of the ſubtil, penetrating, elaſtic fluid, that ſurrounds and preſſes in all directions upon them; and this is air. Water may be, for a while, freed from air, by certain degrees of heat, and by taking off the whole preſſure of the atmoſphere by an air-pump; but, in proportion as the heat is removed, or the preſſure of the atmoſphere is reſtored, the circumambient air, with all its contents, will be imbibed by, and, in ſome proportion, imbodied with, the water. Hence, we hardly ever find water in the natural ſtate, fluid, ſo effectually diveſted of air, as to admit of making the experiments for proving its incompreſſibility, with due propriety and exactneſs. From hence, we may eaſily account for the variety, that appears in the different relations of ſimilar experiments recorded by different authors, of equal credit and reputation, in moſt other reſpects. The celebrated ITALIAN PHILOSOPHERS * have tried to condenſe or compreſs water by various means. As 1. By the preſſure of the elaſtic vapor of water. This was increaſed to a degree not onely ſufficient to burſt glaſs veſſels, but to break through the ſolder of braſs ones; yet, without making any impreſſion upon the ſurface of water in a tube, on which the whole force was impreſſed. 2. The like trial was alſo made with quick-ſilver; with the like ſucceſs: for, a column of water was found not to yield an hair's breadth to the

* Academ. del Cimento, Lat. Edit. by Van MUSSCHENBROEK.

utmoſt weight of mercury, the containing glaſſes could bear, which was eighty pounds. 3. The third trial was by filling a thin ſilver globe with water, cooling it with ice or ſnow, and ſtopping it with a very firm and cloſe ſcrew. The globe thus filled and ſtopped, being on all ſides gently ſtruck with an hammer, was bulged in at every ſtroke; but, the water, inſtead of ſuffering itſelf to be compreſſed, made its way through the pores of the metal, as quickſilver paſſes, upon preſſure, through the pores of leather. What extraordinary reſiſtance! What extreme tenuity of parts!

§ 70. DU HAMEL, an ingenious and acurate philoſopher, further confirms the third experiment; by filling a golden ſphere perfectly with water and afterwards compreſſing it equally; whereupon the water tranſudes by the pores of that moſt ſolid metal, inſtead of yielding to the compreſſure. This, at the ſame time, demonſtrates the extreme ſubtility and penetrability of water, as it proves its incondenſability or incompreſſibility, which undoubtedly ariſes from the extreme hardneſs of its conſtituent particles.

§ 71. Theſe experiments receive new weight and light by the exact and faithful experiments of the famous TRANSLATER and COMMENTATOR of the FLORENTINE ACADEMICIANS, in oppoſition to ſome other philoſophers, whoſe experiments ſeemed to denote, that water was in ſome degree compreſſible. This faith-worthy philoſopher filled two ſpheres of lead and tin, each of three inches diameter, and one tenth of an inch thick, with water freed from air by the air-pump in cold weather, and then placing theſe ſpheres under receivers, and exhauſting them by the pump, aſſured himſelf, they were filled with water onely; then ſtopping the tube, by which they were filled, by driving a leaden pin a finger's breadth into it, and afterwards cloſing it well with ſolder, he placed each in a preſs, where they re-

*. M. VAN MUSSCHENBROEK.

quired

quired the force of a conſiderably long leaver before they took any impreſſion. And, as ſoon, as the figure of the ſphere was ſeen to alter, its ſurface was all over covered with a thick dewy tranſudation, which increaſed, as the preſſure was augmented. This, he has frequently demonſtrated in his public courſes in the univerſities of Utrecht and Leyden.

§ 72. Mr. KING, in his courſe of experiments in natural philoſophy, ſhews a copper ſphere, in the orifice of which, a ſtrong, cloſe ſcrew is made, to which a ſcrewpin, with a fit handle is adapted. This ſphere being filled with cold water, the ſcrew, being well greaſed, may be turned with proper force. But, it is no ſooner turned, ſo as to compreſs the water with any force, than the fluid eſcapes, as above, through the pores of the metal.

§ 73. Hence, it is juſt to conclude, with M. V. MUSSCHENBROEK, that Lord VERULAM, M. FABRY, COLBERT, MAGIOTT, BOYLE and others were deceived, when they pronounced water compreſſible from its running out with rapidity by a perforation made in a globe filled with water and compreſſed by ſcrews or otherwiſe; and it is reaſonable to judge, that this current of water was owing to air contained in the water, or ill-filled ſphere, or to the elaſticity of the metal, which had yielded to the force impreſſed upon it in filling it with a ſyringe. The ſtricteſt care is to be taken in the making theſe experiments: For, though the air commonly contained in the pores of water, be not elaſtic there, while the liquor continues cold and fluid; yet, upon ſlight heat, it will recover its elaſticity, the water itſelf will be rarefied, and it will ruſh forth with rapidity by any aperture; or, if the heat be ſufficiently increaſed, it will burſt the ſtrongeſt veſſel with a moſt loud and violent exploſion. All metals are capable of expanſion and contraction by heat and cold, and are alſo all more or leſs elaſtic. Wherefore, he who makes theſe like experiments, without due regard to theſe circumſtances, will eternally deceive and be deceived.

§ 74. Water is an uninflammable fluid. The utmoſt force of fire can not raiſe the heat of water above two hundred and thirteen degrees, in which it boils. We are not yet able to aſſign a ſatisfactory cauſe, why certain bodies admit of certain degrees of heat and no more. Until we are, we ſhall not be able to ſhew, why ſome fluids are, and others are not, inflammable. Here, as in many other inſtances, we muſt be content with knowing little more, than the effects alone. We find then, moſt fewel requires greater heat to kindle it and make it burn, than two hundred and thirteen degrees. But, water is not capable of more; therefore, it can not be inflammable or burn; but, on the contrary, muſt extinguiſh fewel ſet on fire, while it is yet boiling hot; becauſe, even at the utmoſt heighth of its heat, it diminiſhes the degree neceſſary to burn fewel.

§ 75. Though water be uninflammable, it is capable of great rarefaction and extreme expanſion, with moſt remarkable elaſticity. All bodies are rarefied and expanded by fire; as they contract or are condenſed by cold. And no body, that is not ſuſceptible of greater heat, is more ſenſibly affected in this way by fire, than water. Every degree of heat above the thirty ſecond, keeps water fluid, conſequently in motion, which is increaſed, as far as the two hundred and twelveth or thirteenth, and no higher. In all theſe degrees of heat, the water is in itſelf rarefied and expanded, while part of it is diſſipated in inviſible or viſible exhalations or vapors; than which, there is hardly anything more elaſtic. The extreme force of water converted to ſteam or vapor by fire is ſhewn in SAVERY's engine for raiſing water by fire, ſuch as is uſed at York-buildings, in ſome of the Chelſea water works, and in our mines. In theſe, the hot vapor confined in a cylinder, overcoming the preſſure of the atmoſphere, raiſes a piſton adapted to the cylinder and annexed to the end of a leaver balanced on pinions in the middle. This vapor being condenſed, by the admiſſion of cold water into the cylinder, takes off the

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reſiſtance, which the heated vapor gave the weight of the incumbent atmoſphere; and thus an alternate motion is given to one end of a leaver, ſufficient to ſet pumps going by the other, to raiſe an immenſe weight of water to any heighth.

§ 76. If a long necked glaſs phial be filled with boiling water, and then ſet by in a cool place, as it cools, the tube or neck of the phial will appear empty, as if ſome of the water had exhaled. But, upon giving it the ſame degree of heat again, the contained water will be again rarefied and will expand ſo far, as to occupy the ſame ſpace it did before. This effect is produced, not by attenuating or dividing its component particles, but by agitating them againſt one another and expanding them or enlarging their bulks, which cold alone can reduce.

§ 77. If two glaſs phials of equal ſtrength and dimenſions be taken, the one filled with gun-powder, and in the other one drop of cold water be inſtilled; then both equally well ſtopped and ſet on the fire; it will be found, that the former will burſt with a ſlight noiſe, the latter with a loud and violent exploſion, that will throw the fire and glaſs about forcibly *. This ſhews the power of water, rarefied into vapor, to excede that of gun-powder. And, I am apt to think, moſt earth-quakes are produced by the ſudden rarefaction of water by ſubterranean heat, where the vapor has no vent: for, I know no body capable of reſiſting the expanſive force of the ſteam of boiling water confined.

§ 78. Some ignorant perſons, to prevent the boiling over of unctuous and emplaſtic bodies, with pitch, reſin and the like, or to extinguiſh them when ſet on fire, throw water upon them; but, this always increaſes the evil, it is deſigned to remedy or prevent: for, the water is rarefied by the heat, and burſts out with rapidity and exploſion, proportioned to the heat and the reſiſtance, it meets from the tenacity of the pitch or

* M. V. MUSSCHENBROEK.

reſin, and ſo increaſes the boiling and combuſtion. This expanſive force is well known to founders, eſpecially of braſs and iron. Theſe often fatally experience the dreadful effects of caſting their fuſed metals into wet moulds. The ſlight moiſture barely neceſſary to make the ſand, of which their moulds are made, cohere, never fails of cauſing ſome exploſion. But, if they happen to be more moiſt, than ordinary, then the exploſion is ſo extremely violent, as not onely to ſhock dreadfully, with its ſound, but to burſt the moulds and throw the metal about with horrible force, to a conſiderable diſtance. There is nothing more ſurpriſing and to us unaccountable, than that water, which is not onely incompreſſible, but abſolutely inelaſtic, ſhould by fire be rendered ſo ſenſibly and powerfully elaſtic, and again, by certain degrees of cold, be totally ſpoiled of this quality.

§ 79. To this may be added the extraordinary power of rarefied and agitated water confined, in diſſolving the hardeſt parts of vegetables and animals. The hardeſt bone may in a few minutes be diſſolved in Papin's digeſter. So that water thus becomes the moſt penetrating of all known fluids: for, if we except fire and light, magnetic and electrical effluvia, we ſhall find nothing ſo powerful in pervading bodies, as water, in this ſtate eſpecially.

§ 80. As water is partly indebted to fire for its fluidity, and is by heat capable of rarefaction and expanſion, with extroardinary elaſticity; ſo is it ſpoiled of all theſe properties by cold; that is, in thirty three degrees of heat, it is fluid, but neither rarefied nor expanded ſenſibly, nor does it ſhew any ſign of elaſticity. And, in thirty two degrees, it changes its form and nature, and from an inelaſtic fluid, becomes a ſolid elaſtic body; to wit, ice. This ſurpriſing metamorphoſis has induced ſome * to pronounce ice the natural ſtate of water. But, this expreſſion is a little too

* BOERHAAVE's Elem. Chem. Tom. I. p. 614, in marg.

vague:

vague: for, water is deſtined to ſerve innumerable purpoſes in the creation, which ice can not effect. Water is deſigned to be the habitation of as great a number and variety of animals, as are known on the dry ſurface of the earth. They were ſurely made to inhabit a fluid, not a dry and ſolid, element. And to theſe, it can prove the vehicle of nutrition in a fluid, not in a ſolid, ſtate. There are, it is certain, parts of the world, where the cold is ſuch, as keeps water always in a ſolid ſtate, that is, froſen. Here, it is undoubtedly natural; the laws of nature eternal and irrevocable have made it ſo, at the poles of this globe, where thirty three degrees of heat can never be known. But, when and wherever that degree of heat is felt in the atmoſphere, then and there, froſt can not be ſeen, and there, water muſt remane fluid: wherefore, fluidity may, at leſt with equal reaſon, be pronounced the natural ſtate of water *.

§ 82. Ice is looked upon, by the ſame author, as a certain kind of glaſs, which fuſes or liquefies in thirty three degrees of heat, and, in any degree under that, becomes again hard and ſolid. Then, it acquires the principal characteriſtics of glaſs; it becomes an hard, elaſtic, fragile, pellucid, inodorous, inſipid body, which bears cutting and poliſhing like glaſs, and may be formed into Lenſes and burning-glaſſes. In what then does it differ from common glaſs?—In gravity, fuſibility and fixity. It has been before obſerved, that water, in itſelf, inelaſtic, is by fire rendered powerfully elaſtic. Here the ſame effect is produced by the abſence of heat, cold: for, a globe of ice, falling on any hard body, rebounds, as a globe of glaſs does. And the colder, the harder and more elaſtic it is always found. Some have imagined, that in long con-

* How juſtly phyſical, as well as elegantly poetical, has our MILTON painted this, in his matchleſs poem on Paradiſe Loſed.

——— On the watery calm.
His brooding wings, the Spirit of God outſpread,
And vital virtue infuſed and vital warmth,
Throughout the fluid Maſs. ——— ———

tinued and extreme cold, water is actually converted into gems or cryſtal. But, this muſt paſs for a groundleſs conjecture; till better authority be given, than has as yet appeared: for, as far as we can diſcover, the freeſing of water onely offers an other argument to prove the immutability of its nature; becauſe, the hardeſt ice, we have ever ſeen, has thawed in every degree of heat above thirty two, and then was always found to poſſeſs the ſame character and qualities preciſely, that it had done before that transformation.

§ 82. Ice differs from glaſs not onely in fuſibility, but in fixity: for, common glaſs ſtands the utmoſt degree of fire without waſte. Whereas, ice is capable of being volatiliſed by the degree of heat, ſufficient to fuſe or thaw it.

§ 83. Another material inſtance, in which ice is found to differ from glaſs, is that of gravity. All glaſs is heavier than water; ice in general, more light. But, this is accidental: as water cannot be obtained, and expoſed to freeſe conveniently, without air; ſo ice without air is hard to be found. The interſtices of water are always found full of air. And, though this air, by the diſunion of its parts by the mixture of any other fluid, loſes its elaſtic property; yet, as the particles of water are brought into cloſer contact and union by the freeſing cold; ſo the particles of air, before diſunited, now come together and form air bubbles with all their natural properties. Theſe it is, which expanding give that levity to ice, as to make it float upon the very water, of which it was formed. And, it is this expanded air, that burſts the ſtrongeſt known veſſels, filled with water, ſtopped and froſen *.

§ 84. If water were to be thoroughly freed from air, by expoſing it to cold, more ponderous ice may be obtained. Thus, water froſen after boiling, or in vacuo, gives ice, more ſolid and ponderous, more equal and pellucid, than ordinary. The FLORENTINE PHILOSOPHERS † have thus made ice, that would not

* See the Exp. of the Acad. del Cimento.
† Acad. del Cimento.

float

float upon water. Whence, we may conclude, its levity is folely owing to the air, contained in the water. Whoever then is desirous to see ice of this kind, let him take the pureſt water, the freeſt from air, as well as terreſtreity, and freeſe it in the greateſt cold of nature, aided by art, according to the Florentine or Fahrenheit's method, and he will have the pureſt and hardeſt ice. But, with all his care, it will be ſtill found fuſible in thirty three degrees of heat. Whence, we may conclude, that the notion of water's being converted into gems or cryſtal by the natural cold is ridiculous; ſince that, augmented about forty degrees by art, proves utterly ineffectual to this purpoſe.

§ 85. The component parts of common water are very heterogene. There are few bodies in nature, into whoſe compoſition water does not enter, or to whom it does not, in ſome manner or form, adhere. And there are very few bodies, that are not capable of being, by one means or other, ſuſpended in water. Hence, we find the pureſt water in nature always charged, in ſome proportion, with all the other elements, as fire, air, and earth of various kinds.

§ 86. We have already ſhewn, that water in a fluid ſtate can not exiſt without thirty three degrees of fire; under this, it is converted into an hard ſolid body, ice.

§ 87. At the ſame time, it has appeared, that air is always imbibed, in ſome proportion, by water. There is no water, that does not diſcharge much air, upon being heated, as well as froſen, and upon being put under the exhauſted receiver of an air-pump. And as ſoon, as the cauſe, that expelled this air, is removed, new air ruſhes in and fills the interſtices of the water, as before. Some water has more of this air, than others; the light mineral or chalybeate waters of Pyrmont and Spa, moſt of any.

§ 88. The exiſtence of earth in waters is manifeſted upon evaporation or diſtillation to a dryneſs. Some are ſo charged with earthy or ſtoney matter, as to grow milkey upon boiling, or to coat the veſſel in

which they are boiled, with ſuch a ſubſtance. But, the lighteſt and pureſt known in nature is not free from this mixture, nor can it be totally diveſted of it by art. For, in evaporation to a dryneſs, in the moſt careful manner, a conſiderable quantity of ſolid earthy matter remanes. And, in diſtillation, in the cloſeſt veſſels, the like ſediment is left, and that after many repeted diſtillations.

§ 89. Mr. BOYLE informs us *, not altogether upon his own knowledge indeed, that rain water diſtilled near two hundred times, in clean glaſſes, always left a white, inſipid, terrene ſediment in the bottom.

§ 90. This may be true, if water could be diſtilled ſo often without entirely evaporating at the beſt cloſed junctures, which may be reaſonably doubted. But, taking the poſition for granted, all the earth remaning after this proceſs is not to be entirely attributed to the water: for, as water can not be diſtilled, much leſs evaporated without air, and as there is none air free from duſt or other ſubtil terrene matter ſuſpended in it; it is not to be wondered, that water paſſing through new air, at the ſame time, that it parts with ſome of its terreſtreity in diſtillation, ſhould collect more from the air in the empty part of the diſtilling veſſels, through which it neceſſarily paſſes. So that, as rain is looked upon as the ley or waſh of the atmoſphere; ſo water, with all the ordinary cautions diſtilled, may juſtly be conſidered onely as the ley or waſh of ſuch a portion of that air or atmoſphere, as neceſſarily occupies thoſe parts of the diſtilling veſſels, which are not filled with the liquor to be diſtilled.

§ 91. Thus, though diſtilling be the moſt effectual method, we know, of purifying water, we are not to expect it more pure after repeted diſtillations in the ordinary manner, than after one; nor are we to ſuſpect, that all the earth, which is ſeparated from it in repeted diſtillations, preexiſted in the water.

§ 92. To diſtil water, ſo as to render it as pure, as poſſible, I recommend the following Apparatus and method;

* Of forms and qualities.

§ 93.

§ 93. 1. A glaſs cucurbit of a convenient ſize, with a moor's head and beak, all of a piece, and a perforation at the crown of the head, to which a glaſs ſtopple ſhould be ground and adapted.

§ 94. 2. A long necked matrace, tubulated at the boll, to ſerve as a recipient.

§ 95. 3. A ſtrong glaſs bottle, large enough to contain the quantity of water to be diſtilled, with a long neck and a mouth adapted to the tube of the recipient.

§ 96. 4. A convenient ſand-bath furnace, in which the cucurbit may be placed for diſtillation.

§ 97. The method of proceding, I recommend, is this; let three fourths of the cucurbit be charged with the cleaneſt and neweſt collected rain, or rather ſnow water. Let it be placed in the ſand-bath, within three fingers breadth of the pot, and let it be covered with water, about half as high, as the water to be diſtilled. Then, let the tubulated matrace be joined by way of recipient to the beak of the moor's head. Let its boll be ſupported by a convenient round, with its tube inverted into the bottle, which is to receive the diſtilling water. Having luted the junctures with a thin paſte made of fine almond or linſeed meal one part, wheaten flower two parts and the glare of eggs a ſufficient quantity, let the fire be gradually adminiſtered and regulated, with the neceſſary cautions, till the water is all diſtilled.

§ 98. Thus water, pure enough for moſt experiments, may be obtained. But, as it is to be preſumed, that while it loſſed the quantity of earth, which is found in the bottom of the cucurbit, it gained more from the air in the veſſels, through which it paſſed in the diſtillation, if the veſſel No. 3. be removed, before all is cold, and the water poured back into the cucurbit, by the opening in the head, letting it touch none of the external air, it may now be diſtilled through a purer medium, than before, partly through that very air, which it had in the former diſtillation waſhed, with ſome new to fill up the ſpace of that, which was expelled

in

in the rarefaction by the diſtilling heat. And thus, by a ſecond or third diſtillation, without removing the veſſels or opening them ſo, as any conſiderable quantity of the impurities of the external air ſhould enter, water may be diſtilled to the utmoſt purity, of which we as yet know it capable.

§ 99. This diſtilled water may ſerve as a ſtandard, by which all others may be tried, by compariſon. It will be found the lighteſt upon the balance; although rain or ſnow may, at ſome times and in certain places, be collected ſo, as nearly to equal it in this reſpect.

§ 100. The purity of water is determined by the following, among other analogous, experiments.

§ 101. Soap diſſolves in ſpirit of wine. This ſolution dropped into pure water mixes ſmoothly and equally with it. But, in impure or hard water, it coagulates or curdles, the ſoap being firſt ſeparated in clouds, and afterwards decompoſed; that is, the ſalt and oil or fat, that compoſed it, parted.

§ 102. The pureſt water is eaſieſt heated and ſooneſt cooled. Common waters are heated or cooled ſooner or later in proportion to the quantity of ſolid parts ſuſpended in them. The harder or more charged any water is, the more difficultly it is heated and the more ſlowly it is cooled. Conſequently the more unfit for diſtillation, and the leſs apt to freeſe. Petrifying waters are rarely froſen.

§ 103. The metalic ſolutions, particularly thoſe of gold in aqua regia, that of ſilver and of quickſilver in the acid of nitre and that of lead in diſtilled vinegar, all ſuffer themſelves to be diluted with, and remane ſometime ſuſpended in, this pure water; whereas, in leſs pure waters, thoſe charged with terrene or ſaline parts eſpecially, upon theſe ſolutions being dropped into them, they grow turbid or cloudy, and the metals are ſuddenly precipitated in the form of a magiſtery, for reaſons hereafter to be aſſigned.

§ 104. Though we have not as yet found the means of reducing water to perfect, elementary ſimplicity; yet,

yet, we find it in ordinary the ſimpleſt, as it may be looked upon as the baſis, of all other fluids.

§ 105. Hence, the extraordinary lenity or mildneſs of water; that is, its freedom from all ſharpneſs or acrimony. This quality renders water inoffenſive and perfectly agreeable to the parts of moſt exquiſite ſenſibility in an animal body, when by fire it is brought to the ſame temperature with the juices of the animal. Thus, it cauſes none uneaſy ſenſation in the eye, nor excites any ſmell or gives any kind of irritation to the noſtrils, where the fine branches of the olfactory nerves lye almoſt bare. Likewiſe, in wounds and ulcers, where the membranes or nerves are layed bare, and can ſuffer none other application, without increaſe of pain, warm water mollifies and aſſuages. And in the moſt violent inflammations, where every thing, that touches, whether ſolid or fluid, increaſes the acuteneſs of the pain, warm water, or its vapor, brings preſent eaſe and comfort. As it mixes with, diſſolves and dilutes all ſharp and corroſive ſalts, it muſt have the like good effect taken internally, where ſuch are found to predominate; whence, it has, in theſe like intentions, internal, as well, as external, obtained in practice from the earlieſt ages of phyſic, till, by a ſhameful and unaccountable infatuation, it became ſo far neglected in this conceited age, in which we live, that a BOERHAAVE or an HOFFMAN may not be hoped able to reſtore it to its priſtine uſe and reputation.

§ 106. The great ſimplicity of water has given it alſo the extraordinary quality of being the moſt powerful, the moſt univerſal ſolvent, as yet known in nature or art. Thus, water is found more generally and effectually to inſinuate itſelf, than any other liquor, into the pores and interſtices of a great variety of bodies, to break their connections and divide them into parts ſo fine, as to be capable of mixing with, and being inviſibly ſuſpended, in this fluid; ſo that the body diſſolved ſhall be ſo equally diſtributed between the parts of the ſolvent or water, that in every part thereof,

of, a proportionate quantity of the matter diſſolved is always found.

§ 107. The bodies, which water diſſolves with the greateſt facility are ſalts of all kinds, whether ſolid or fluid, natural or artificial.

§ 108. The ſalts, which water moſt commonly meets in its paſſage through the earth, are the ſolid foſſil ſalts; either ſimple, as ſal gem, or ſea ſalt, ſal ammoniac, borax, nitre of the antients, or theſe compounded together. To which, the various vitriols may be added. The other ſimple foſſil ſalts are never found naturally pure, in a ſolid or dry form; but, from an extraordinary attraction with water, always imbibe enough of it to ſecure to themſelves a liquid form; unleſs when they unite with ſome terrene baſe. The firſt of theſe, and ſeemingly the firſt in the creation, is that univerſal acid, which pervades the whole ſyſtem of nature, and though it be called foſſil, from its being collected in greateſt plenty from certain foſſil bodies; yet, we can trace it in the vegetable and animal creations, though ſomewhat altered from the original; and the whole region of the air is charged with it; as appears from the corroſion of metals and the ſaturation or neutraliſation of alkaline ſalts; that is, the expoſing fixed alcaline ſalts to the open moiſt air; by which, the ſame effect will be produced, in a certain time, as if they were immediately ſaturated with the ſame acid procured by art; to wit, the concrete, called, tartar vitriolate, will be the reſult. This affords a proper caution in the preparing the ley of alcaline ſalts, as that, called, the oil of tartar, in particular, which is directed to be made by expoſing this alcaline ſalt to the open air, till it abſorbs humidity enough to diſſolve it. But, in being thus expoſed, it muſt, with humidity, always imbibe more or leſs acidity, and conſequently be, in ſome meaſure and degree, neutrated. Hence, we can find no common alcaline ſalt without ſome neuter ſalt with it, and that commonly tartar vitriolate. This acid abounds in various parts of the earth, ſo as to produce various concretes, from whence we obtain it by art. Thus, the univerſal acid with iron makes green,

green, with copper, blew vitriol, or copperoſe; with zinc, white vitriol; with the inflammable principle, called, Phlogiſton, ſulphur or common brimſtone; with a certain earth, alum, and ſo forth. From theſe, the green vitriol and ſulphur eſpecially, we extract this acid by fire; whence, it vulgarly bears the name of the concrete, from which it was drawn; though it be but one and the ſame, whence ſoever drawn, when perfectly pure. This acid may be obtained by a particular proceſs in a ſolid, icy form, in which, it is impoſſible to keep it long. But, in all the ordinary operations, it imbibes, with great avidity, enough of the humidity of the air, to keep it conſtantly liquid. And it holds this moiſture ſo faſt, that no degree of fire will afterwards ſeparate them. This is looked upon as the baſis of all the other acids, produced by nature or art; whence, it is by ſome called, primogenial.

§ 109. The other liquid, foſſil acid ſalts are the acid ſpirits of common ſalt and modern nitre. Theſe are always liquid, nor can they be obtained in any other form, from their firm union with water, and their volatility, which is not inferior to that of water.

§ 110. The ſolid and liquid ſalts are all ſoluble in water; but, in a different manner and proportion. The ſolid will all diſſolve in water; but, they each require a certain proportion of the fluid to diſſolve them, and the ſolvent may be ſo ſaturated, that it can take up no more of the ſolid ſalt, but leaves it untouched, as if it were not ſoluble therein. But, when the ſalt is once equally diſſolved in a ſufficient quantity of water; then it is capable of being further diſſolved or diluted with any greater or leſs quantity of water. Thus, the acid ſalts, being always in a fluid form; that is, already diſſolved in a ſufficient quantity of aqueous humidity, may be diſſolved in the ſmalleſt quantity of water imaginable, that is, further diluted therewith.

§ 111. It is by being in continual motion, that water effects the diſſolution of bodies. By this it is, that the ſeveral unſaturated parts of the ſolvent come into contact with, and act upon, the ſolvend. This is proved

proved by the diſſolving power of water being increaſed by heat, which onely augments its motion, and is further evinced by the ſalts ſeparating from the water, when by cold it is brought into a ſtate of reſt or inaction. Thus, for inſtance, if a ſolution of any of theſe ſolid, foſſil ſalts be expoſed to air cold enough to deprive the water of motion, that is, to freeſe it; in proportion, as the cold increaſes, the ſalt will ſeparate from the water; and the water reduced to ice will be found void of ſalt. And thus may ſea ſalt be prepared in cold climates, where fewel may be ſcarce*.

§ 112. Heated water diſſolves more of any ſalt, than cold. But, when thus charged, as ſoon as it cools, the ſuperabundance will ſeparate in its natural form, leaving no more in the water, than it was capable of diſſolving when cold.

§ 113. Water not only diſſolves more of one ſalt than of an other, but when ſaturated with one ſalt, will receive more of another. The foſſil ſalts, that contain moſt water and leſt earth, are the moſt ſoluble: Thus, ſal gem, ſea ſalt or nitre, are more ſoluble, that is, require a ſmaller quantity of water to diſſolve them, than borax or alum; and water fully ſaturated with ſea ſalt, will ſtill take in ſome nitre, and then ſome other ſalts, and keep all equally diſſolved.

§ 114. But, theſe are not the onely ſubjects ſoluble in water: it takes in all the metalic or terreſtrial ſalts; ſuch as, all the vitriols or metals diſſolved in acid ſalts, whether of the mineral or vegetable kind. The former compoſe mineral waters of different kinds. And various ſtones or earths diſſolved in the like acids are miſcible with water; and thus our hard and petrifying waters are conſtituted.

§ 115. However, ſome exceptions lye againſt this rule: certain of the ſemimetals, by different artifices, are diſſolved in certain acids. As for example; regulus of antimony is not ſoluble in ſpirit of ſalt, in the aggregate ſtate, no more is quickſilver. But, corroſive ſublimate, which is quickſilver reduced to a vitri-

* STAHL.

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olic or cryſtalline form, by means of ſpirit of ſalt concentrated, in ſublimation, being mixed with this regulus and deſtilled together, the acid of ſalt, from a ſtronger affinity or more powerful attraction with the regulus, quits the mercury to unite with the antimony, volatiliſes it and ſo deſtils into an ice-like ſubſtance, called, butter of antimony. This attracts the humidity of the air and is thereby diluted, in time to the conſiſtence of an heavy oil. This may be looked upon as a ſolution, or a kind of vitriol of antimony, by means of this acid; yet, it is not ſoluble in water: for, as ſoon, as this butter, or oil, as they are improperly called, is dropped into water, the reguline parts ſeparate and fall to the bottom in the form of a white magiſtery or powder, falſely called, mercurius vitae, by ſome; imagining it to be mercury, when in fact it is antimony; by others, pulvis algaroth. In like manner, Biſmuth diſſolves in the acid ſpirit of niter; and may, when diſſolved, be looked upon as a kind of liquid vitriol of that metallic. Yet, when dropped into water, it is precipitated in a white magiſtery, as well as the aforeſayed regulus.—A preſumption, that water may not be impregnated with theſe bodies, as ſome may have vanely imagined.

§ 116. The ſalts of the vegetable and animal kingdom, whether produced by nature or art, and of what kind ſoever they be, are all ſoluble in water, upon the ſame principles with the preceding. And water, charged with different ſalts, becomes a ſolvent for bodies, which, while ſimple, it could not affect: thus, charged with acid ſalts, it diſſolves various metals and earths; and, impregnated with alcaline ſalts, it becomes a ſolvent for oils, ſulphur, *&c.*

§ 117. As it may be ſatisfactory to ſome readers, I here inſert ſome tables, ſhewing the proportion of different ſalts, which a given quantity of ſimple cold water is capable of diſſolving and retaining. This method of calculation was begun by that acurate phyſician and chemiſt, the late doctor FRIDERICK HOFF-

MAN *. But, as ſome in making theſe experiments, may poſſibly find theirs differ from thoſe of this juſtly famed Profeſſor; let me here remind them of ſome defects in the making and recording of theſe experiments, and theſe are, the not determining the purity of the water and the not ſpecifying the degrees of heat or cold of that, in which theſe ſolutions were made, by ſome regular thermometer, whoſe conſtructure and ſcale was made known. Without this, there can be nothing determined with due acuracy from ſuch experiments as theſe, but little from hydroſtatical experiments upon or in water; or even in the meaſuring of it: For, as water is continually changing its temperature with the atmoſphere; as it is rarefied and expanded with heat and condenſed with cold; and as in the one ſtate, its motion is increaſed and with that, its diſſolving faculty augmented; and in the other, it is more at reſt, and conſequently leſs capable of diſſolving; the ſeveral degrees of heat or cold, before and after the adding of the ſalts, together with the purity or ſimplicity of the water, ſhould be moſt acurately determined and ſet down, in order to enable us to draw certain concluſions from the premiſes. For want of due regard to theſe cautions it is, that no two agree in the quantity of water requiſite to diſſolve a given portion of any ſalt. I ſhall, for the ſatisfaction of the reader, ſet down the obſervations of Hoffman, Juncker and Boerhaave upon this head.

* Obſ. Phyſ. Chym

§ 118.

§ 118. HOFFMAN's table, shewing the proportion of water requisite to dissolve certain salts.

Sea-salt,	4 ½ ounces,	These several portions dissolve, each in one pound of common water.
Nitre, or Saltpetre,	6 drachms,	
Copperose,	6 ——	
Alum,	2 ounces,	
Arcanum duplicatum, Tartar vitriolate, or Sal Polychrest.	2 ——	
Epsom salt,	1 pound,	
Fixed alcaline salt,	near 9 ounces	

§ 119. JUNCKER's table for the same purpose is carried further; thus;

Crude tartar powdered,	1 drachm,	Dissolve each in one pound of common water.
Arcanum dupl. or tartar vitriolate,	1 ounce;	
Saltpetre,	2 ounces,	
Alum,	2 ——	
Vitriol,	4 ——	
Sea-salt,	6 ——	
Fixed alcaline salt, according to its purity,	from 1 pound to 1 ½ pound,	

§ 120. These are both defective for want of determining the purity and temperament of the water; and give but imperfect hints, which require further improvement.

§ 121. BOERHAAVE's scheme is carried still further and with greater accuracy. According to his

plan, the ſalts all powdered and dried, the water purified by diſtillation, and its temperament, with that of the atmoſphere, determined, by the thermometer, at thirty eight, diſſolve in the following proportion; to wit,

Sea ſalt, ——	2 ounces,	in diſtilled water, 6 ounces, 3 drams.
Salt gem, ——	1 ounce,	3 ounces, 2 drams,
Salt ammoniac,	1 ounce,	3 ounces, 2 drams.
Saltpetre, ——	9 drachms,	6 ounces.
Borace, ——	4 drachms,	10 ounces and upwards.
Alum, ——	1 ounce,	14 ounces.
Epſom ſalt, ——	1 ounce,	1 ½ ounce.
Fixed alcali, or ſalt of tartar,	1 ounce,	1 ½ ounce.
Arcanum dup. or tartar vitriolate, with long and ſtrong agitation,	4 drachms,	3 ounces.
Common green vitriol by continued agitation,	1 ½ drachm,	3 ounces.
Tartar purified,	1 ounce,	1 pound 8 ounces.

§ 122. Theſe experiments may at firſt ſight appear of little moment. But, by them, we learn the different power of water in diſſolving ſeveral ſalts. Some, it diſſolves more readily, ſome, more tardily and difficultly than others; ſome in greater quantity than others. The knowledge of this is of great importance; as it ſhews us how far a given quantity of pure water is capable of being impregnated with various ſalts, and thereby greatly aſſiſts in the purification and cryſtalliſation of ſalts: As for example; if any ſalt be impure, it is to be depurated by ſolution in a ſufficient quantity of water, and then evaporated to dryneſs, in ſome ſorts, till

till a pellicle appears on the ſurface, in others; and then, ſuffered to ſtand in a cool place to cryſtalliſe. He, that knows the quantity of water neceſſary for this purpoſe, will ſpare himſelf much expence and labor, which the ignorant of theſe rules is likely to ſuffer. Again, if two or more ſalts be mixed, as they may be, not onely in a dry form, which is eaſily conceived, but in a liquid form; for, ſeveral ſalts diſſolved may be mixed together without precipitation, or any other change; this table ſhews how they may be ſeparated; thus, ſaltpetre, ſea-ſalt, ſalt gem, ſalt ammoniac, borace, alum, Glauber's ſalt, Epſom ſalt, and the like will mix uniformly together; moreover, water ſaturated with one ſalt, is capable of receiving and diſſolving ſome of another: as for inſtance; if to the ſolution of ſea-ſalt, in the laſt table, half a drachm of ſaltpetre in powder be added, it will readily be diſſolved in it; or, if to the ſaturated ſolution of ſaltpetre, about half an ounce of ſea-ſalt be added, it will readily diſſolve therein. Or, if to the ſolution of ſea-ſalt a certain portion of alum be added it will diſſolve, when it cannot take up another grain of ſalt; and when it is thus charged, as far, as poſſible, with theſe two ſalts, it will then take in a third; for, it will diſſolve a ſmall quantity of green vitriol. Now, if any two or more of theſe ſalts were thus diſſolved together, we may hence learn how to ſeparate them: for, the ſalt, which requires moſt water to diſſolve it, will, after evaporation, firſt cryſtalliſe, and leave the others in a ſtate of ſolution, till by further evaporation, the next in order is brought to the ſame point, and ſo on. Thus, the alum will firſt cryſtalliſe, next the nitre or ſaltpetre, and the ſea-ſalt laſt. All ſalts, that are capable of being cryſtalliſed, are diſtinguiſhable by the figures of their cryſtals. It is an eſſential mark of their purity; they ſhould therefore be prefered in this form. The waſhings of diaphoretic antimony yield two kinds of ſalt; the one nitrous, the other alcaline. If this be evaporated to a dryneſs, a ſaline concrete, compoſed of

theſe two, is obtained. But, let it be evaporated by this rule, and each ſalt will be obtained ſeparately in its own proper form. In like manner, in preparing the arcanum duplicatum from nitre and vitriol diſtilled by a violent fire, or calcined together; in this preparation, the acid of the vitriol quits its own metallic baſe, to unite with the alcaline baſe of the nitre; whence, a neuter ſalt, like tartar vitriolate, is obtained; but, it may, and often does, happen, that ſome portions of the nitre and vitriol remane quite unaltered; and then, there are three ſalts in the waſhings of the calcined maſs; to wit, nitre, vitriol, and the neuter ſalt, called arcanum duplicatum. The evaporation of theſe waſhings to a dryneſs, it is plane, muſt yield a compound of theſe, not a pure, ſimple ſalt. But, cryſtalliſation, by our rule, gives each ſeparate in the order ſet down. Here, it muſt be obſerved, that all the cryſtalliſed ſalts always contain more or leſs water. To this, their coheſion and pellucidity is owing: for, diveſted of humidity, they fall into an opac powder.

§ 123. Upon the ſame principles, different ſalts, when, by any accident, they happen to be mixed, are ſeparated by mere ſolution or waſhing: thoſe, that are eaſieſt diſſolved, or require leſt water or motion to diſſolve them, will be firſt ſeiſed by the water. Thus, in ſuch a mixture, they will diſſolve in this order; 1. The fixed alcalies; 2. Epſom ſalt; 3. Sea-ſalt; and ſo on, according to the table.

§ 124. The reaſon why one ſalt is thus more ſoluble, than another, deſerves our attention. The ſalts, which conſiſt of the moſt ſubtil parts, are the leaſt ſolid, cohere moſt ſlightly and conſequently are moſt eaſily divided or diſſolved. On the other hand, the ſalts, which are compoſed of more groſs and terrene parts, are moſt denſe and ſolid, cohere more firmly together, ſo that their union is hard to be broken, and they are moſt difficult of ſolution. This is demonſtrated by the table: the ſalts of the former claſs,

which are found to require leſt water and leſt motion to diſſolve them, are the fixed alcaline ſalts, which have ſuch a thirſt, that when expoſed to the open air, they attract a ſufficient quantity of its humidity to diſſolve them, and then retain it ſo firmly, as to part from it with difficulty; and next to theſe, the acid ſalts, which attract and abſorb as much aqueous humidity from the air, as renders them liquid, and then retain this moiſture ſo firmly, that it is impoſſible to part them. Next to theſe, alcaline ſalts neutrated with vegetable acids, as ſalt of tartar with tartar or vinegar; ſuch neuter ſalts, as contain much water; as Epſom and Glauber's ſalts and the like, then muriatic ſalts are found the moſt ſoluble. The ſalts of the later claſs, which require moſt water and motion to diſſolve them, are nitre, alum, borace, vitriol, tartar vitriolate, and tartar. Theſe are all found of the character given, in different degrees; whence, their ſolubility varies. There is another reaſon concurs to make tartar, as it is found, almoſt inſoluble in cold water; it is all over covered with a mucid or kind of unctuous lentor, whence water without heat can hardly enter it.

§ 125. Though all oils, in their own proper nature, be abſolutely inſoluble in water, without ſome proper intermedium; yet, when they are once attenuated and ſubtiliſed by fermentation, ſo far as to become a burning ſpirit, then they imbibe and unite with ſuch a portion of water, as renders them afterwards, as ſoluble, as any ſalt in that fluid. Thus, the beſt rectified ſpirit unites upon mixture with any quantity of pure water; and the purer it is, the quicker the union. If cautiouſly poured the one upon the other, the heavier will preponderate, the lighter float upon the other; but, upon the ſlighteſt agitation, they mix moſt intimately, as before obſerved.

§ 126. Water, however, has a ſtronger attraction to divers ſalts, than to burning ſpirits. Hence, if water be perfectly ſaturated with a fixed alcali, as in the

ley, vulgarly and falsely called, oil of tartar, it will by no means quit the salt, to unite with the spirit; nor can the ley and the spirit be, by any artifice, united. From the same cause, if to any spirit diluted with water, a sufficient quantity of dry, fixed alcaline salt to saturate the water be added, the salt will attract, and be attracted by, the water, they will unite and reject the spirit.

§ 127. But, this happens onely with such salts, as have so powerful an attraction with water, that they are hardly separable: for, all such, as readily quit the water, from their superior volatility, or aptitude to run into crystals, make an exception to this rule. Thus, if water be strongly saturated with a volatile alcali, such as the volatile salt of soot, urine, salt ammoniac or the like, which upon the slightest heat are apt to quit the water and fly off, or with such as run into crystals, when the water is at rest, such as tartar vitriolate, Glauber's, or Epsom salt, upon pouring rectified spirit to strong solutions of these kinds of salt, the water quits the salt, dissolves or unites with the spirit, while the particles of the thus rejected salt attract each other and run into crystalline concretions. Hence, we see, that water has a stronger attraction with some salts, than with a burning spirit, and a stronger attraction with the spirit, than with certain other salts.

§ 128. It has been before observed, that burning spirits were but subtilised oils. Hence, they retain their affinity to oils and dissolve all those, called, essential; such as are destilled in an heat not exceeding that of boiling water, from aromatic vegetables, and even those, called empyreumatic or adust; such as are drawn by the force of naked fire from vegetable and animal bodies. Those obtained by expression, containing something mucilaginous, are not soluble in spirit. Resins or balsams likewise, from their affinity to essential and other oils, in all which they are so-

luble,

luble, readily diſſolve in rectified ſpirits. But, water has a ſtronger attraction or nearer affinity to the ſpirit, than any of theſe. For which reaſon, as ſoon as water is poured into any ſuch ſolution, it immediately becomes opac and milky; the water and the ſpirit attract each other, unite and form a liquor incapable of diſſolving any oil or reſin; whence, theſe are rejected, and, according to their reſpective ſpecific gravities, riſe and float on the ſurface, or fall to the bottom, of the mixture.

§ 129. Oils or oily bodies are not ſoluble in water, without the interpoſition of ſome body, which has a ſtrong attraction with water, and is, at the ſame time, capable of inviſcating or breaking the coheſion of the oils. Thus, divers oils and balſams, as well as certain animal fat, that for inſtance, which is abſurdly called ſperma ceti, divided and inviſcated by the yelk of an egg become miſcible with, though not perfectly ſoluble in, water. The like effect is produced by dropping oils on ſuggar; they may, by this means, be for ſome time ſuſpended in water, which before, could not affect them. But, the moſt perfect ſolution of oils in water is effected by uniting the oils or charging the water with thoſe ſalts, which moſt ſtrongly attract water. Theſe are the fixed alcalies, and next to them, the volatile ſalts.

§ 130. The former, to wit, the fixed alcalies, unite with eſſential oils, upon being mixed dry with them and agitated; and, with expreſſed oils or fat of animals, by being reduced to a ley and boiled and ſtirred together, till the water of the ley be exhaled. Thus, the beſt ſoaps are made. Theſe ſoaps are not onely very ſoluble themſelves in water, but they render that fluid a powerful diſſolvent of various bodies, which it could not otherwiſe touch. Thus, oils and fats, and all unctuous or greaſy bodies, reſins and gummy-reſins mix with ſoap, and by that means become ſoluble in water. Hence, the cleanſing quality of ſoap. The volatile alcalies likewiſe unite with oils, and form a

kind

kind of ſoap; but, their union is not ſo permanent.

§ 131. Having thus in many inſtances ſhewn the extent of the diſſolving power of water, it is not improper to ſhew where it is limited, that it may not be looked upon in the light, in which ſome vane boaſters have placed it; that of an univerſal menſtruum or ſolvent.

§ 132. Pure water, perfectly clear of all ſalts, is not capable of diſſolving any of the metals,* though ſome men of great authority have affirmed, that the moſt pure and perfect were not proof againſt the power of this ſimple ſolvent, but may, by long trituration, be rendered actually ſoluble therein. But, the preſumption is, that if theſe gentlemen made theſe experiments, they either uſed water already tainted with ſome ſalt, or let it ſtand ſo long expoſed to the air in the time of trituration, as to imbibe enough to make it a fit menſtruum for metals moſt ſubtilly divided by grinding. However, let not this induce any one to keep water in metallic veſſels, eſpecially of lead or copper; ſince a ſlight degree of different kinds of acidity may make it capable of diſſolving enough of either to render it noxious. And all ſalts diſſolve more or leſs of copper.

§ 133. Water is not capable of diſſolving any pure earth, or ſtones, much leſs glaſs, cryſtal, or gems. Nor can it diſſolve ſulphur, even by the utmoſt heat, of which it is ſuſceptible, without the interpoſition of a certain ſalt.

§ 134. Such is the extreme penetrability of water, from the inconceivable tenuity of its parts, that it enters into the pores of a great variety of very ſolid bodies, and thereby at once increaſes their weight and ſize. This has already been ſhewn in many inſtances. Here, I ſhall only add a well known experiment to to demonſtrate the dryneſs or moiſture of the atmoſphere.

* Langelot, Homberg.

§ 135.

§ 135. Let a piece of whip-cord or cat-gut, of about a yard long, be braced upon a wall by two ſtrong hooks or nails drove into the wall. Then, let any weight, it is able to bear, be hung from the middle of this cord. And thus a barometer is conſtructed, as juſt as it is ſimple: for, every change of the air to dry or moiſt will be marked by the weight, which will be found lower in dry, and higher in wet or moiſt weather. To prove that the cord is ſhortened and the weight raiſed by water, let it be wet by rubbing a moiſt ſponge or cloth to it, it will be found to contract and raiſe any weight the apparatus is able to ſuſtain. From the ſame cauſe, fiddle-ſtrings are ſo much more tenſe in wet weather than in dry, that they frequently crack and break in the former. This, moſt certainly, is effected by the minute particles of water inſinuating themſelves into the pores and interſtices of the cord; whereby they ſhorten the dimenſions of the cord, in proportion, as they interpoſe themſelves between its fibres, as ſo many wedges would do.

§ 136. From this extreme penetrability, it is no wonder, we find ſo few bodies, to which water does not in ſome manner adhere. Various ſalts dried to the utmoſt, yield an acid ſpirit in deſtillation, whoſe fluidity is owing to water. Thus, ſea-ſalt decrepitated, even fuſed and afterwards mixed with any martial earth dried as well as poſſible, bole for inſtance, will by deſtillation in a violent fire yield a ſpirit, from which pure water is eaſily ſeparated. The ſame may alſo be ſayed of nitre.

§ 137. Sulphur, a moſt dry and combuſtible body, is yet partly compoſed of water: the proofs are, 1. That it flames in burning, and there is no flame without water; 2. That its fumes yield an acid ſpirit, if collected and condenſed in a fit recipient, from whence much water, though it muſt be confeſſed partly from the atmoſphere, may be extracted.

§ 138. An infinite number of bodies owe their ſolidity and much of their weight to water. Clay, without

out water, is but duſt; but, water being added gives it tenacity, and being moulded and baked in a kiln, conſtitutes a ware of a ſtoney hardneſs. Lime and ſand unite into a ſtoney body, that endures for ages, by the addition of water. Gypſum, or the ſtone, called plaſter of Paris, being calcined is reduced to a ſubtil powder; which, upon the addition of water, grows ſolid, dry, and hard as a ſtone. Add to this, that all our glews, ſizes, paſtes, ſtarches, *&c.* derive their tenacity from water alone.

§ 139. The moſt ponderous woods, and the moſt hard and ſolid parts of animals, as their bones, teeth, *&c.* owe the coheſion of their parts, and in ſome meaſure, their ſolidity and gravity to water. This appears upon diveſting them of their humidity, by which they all, more or leſs, loſe theſe properties. As for example; the oldeſt and dryeſt horns, bones, or teeth of animals afford a conſiderable quantity of ſpirit, as it is falſely called, and oil in deſtillation. This ſpirit is no more, than a volatile ſalt, a creature of the fire, diſſolved in the radical humidity of that animal body, which being ſeparated from it, leaves nothing, but water. The ſolid part, thus deprived of its humidity, becomes light and brittle. But, if immerged in water, it imbibes enough to reſtore, in a great meaſure, its former coheſion, ſolidity, and gravity: A proof, theſe qualities aroſe from and chiefly depended upon, water. But, could theſe like bodies be perfectly freed from water, there is reaſon to apprehend, that they would not onely be brittle, as we find them, but that they would have no coheſion at all; that is, fall into mere duſt: for, as the elementary particles of water are not onely of moſt extreme tenuity, but alſo hard, ſolid, ponderous, incompreſſible and immutable, it is not to be wondered, that they ſo firmly adhere to ſome bodies, as not to ſuffer themſelves by any means or force to be ſeparated.

§ 140. It is probable, that Water conſtitutes a part of all fluid bodies, even of thoſe, whoſe nature ſeems

moſt

moſt repugnant to that of water. Thus, we ſee oils, which contain the principle of inflammability in ſuch plenty, as to be entirely combuſtible, and which abhor mixture with water; yet, of theſe, the moſt ſubtil and exalted, not onely thoſe, called eſſential, but even the burning ſpirits, contain much water. This appears, 1. From their burning, in which they all flame, which could not be, without water. 2. From their analyſis; in which all diſtilled oils and burning ſpirits yield a conſiderable quantity of water.

§ 141. Thus, we ſee water makes a conſtituent part of an infinite variety of bodies, from which it appears in its nature the moſt remote. It is confeſſedly the vehicle of nutrition and accretion to all the ſubjects of the mineral, vegetable and animal kingdoms. The hardeſt gems could not have been formed without it; and its uſe to the two other parts of the creation are too obvious to require farther illuſtration. But, it is not to be conſidered merely as a miniſtring matter; but, it is to be regarded as an eſſential part of almoſt all bodies; eſpecially thoſe of the vegetable and animal creations, into whoſe firſt formation it enters, and in which it is moſt demonſtrable. In this ſenſe, water may be conſidered, not onely as an univerſal agent in nature, but as the parent from whence many, if not all other, bodies procede. Hence, the antient chemiſts called water the Univerſal Wine, of which all the minerals, vegetables and animals drank: the reaſon of which will more clearly appear, upon taking a more ſuccinct view of the effects of water upon theſe bodies.

§ 142. It is univerſally agreed, that all bodies, even the moſt ſolid and ponderous minerals, were, ſometime, in a fluid form; which fluidity muſt have been derived from water. Great variety of foſſils are found in a liquid form in the mines. Cryſtal could never keep one certain determinate figure in its formation, nor ſhould we ever find moſs and other ſmall plants or filaments of virgin metals incloſed in it, as we frequently

quently do, had it not been ſometime liquid. The moſt accurate of our mineraliſts and metallurgiſts, of whom GEORGE AGRICOLA is the moſt eminent, aſſure us, that metals themſelves are frequently found in the mines in the form of a groſs, greaſy, ponderous, ſaline liquor, by the ſpagyriſts as well as naturaliſts, called Gur or Guhr. This form, they derive from the ſuperabundant water, with which they are diluted; as appears from their then being miſcible with, and ſoluble in, water; as all vitriolic juices and concretes are found. Hence, we ſee what a principal part water acts in the generation, increaſe, ſolution, dilution and other changes wrought in foſſils in general, in metalics in particular. To me, it appears, that water gives many of them being, as well as helps to bring on their final diſſolution.

§ 143. The part, that water acts in the production, nutrition and accretion of vegetables, is ſtill more evident, as appears from the curious experiments of VAN HELMONT, BOYLE, WOODWARD, and HALES. The pureſt water in the natural ſtate appears to be full of the ſeeds of an infinite variety of vegetables, and of the eggs of numberleſs animals. Not onely the more tender and ſucculent plants, as Hyacinths, Lilies, Mints, Gourds, *&c.* have been proved to derive their nouriſhment ſolely from water, but even trees themſelves, of a more hard, compact texture.

§ 144. The uſe and neceſſity of water to all animals, whether terreſtrious or aquatic, is no leſs evident, than it is to vegetables. To thoſe, it is not onely the vehicle of nutrition, as well as to theſe; but it likewiſe inſinuates itſelf into the frame of the moſt ſolid and ponderous parts of both, as before obſerved; ſo that, without it, nutrition or accretion could in no ſenſe be performed.

§ 145. Moreover, the vital functions could not long ſubſiſt in any animal, without the help of water. This it is, that furniſhes every animal with that bland, mild, ſubtil and penetrating fluid, capable of circulating throughout the veſſels of the whole frame, yea, to paſs

paſs through the moſt cloſe and minute ſtrainers. Without water, in due proportion, to keep all the humors of the body duly fluid, circulation, and with it life muſt ceaſe. Hence, not onely the juices in an animal body, of whatſoever conſiſtence they be, ſo abound with water, that it is found to make the moſt conſiderable part thereof, but the ſolids themſelves owe their cohesion and conſiſtency, if not their origines, to water, as has been before obſerved.

§ 146. Thus, we ſee there is nothing of ſuch univerſal uſe in nature, as well as art, as water. It is the parent and nurſe of an infinite number of bodies. And, as it happens to be conducted and uſed, becomes the chief inſtrument of health and life, or of death and deſtruction. To water we owe all, that affects our ſenſes; 1. Of ſeeing, in the infinite variety of beautiful colors produced by nature or art: for that wonderful machine, the eye, repreſents objects to our ſenſes by the means of humors, compoſed chiefly of water; and the glaſſy or horney coats of the eye, muſt loſe their tranſparency, were they not kept conſtantly moiſtened with water. 2. Of ſmelling; the ſingular odors of bodies are, by means of water, collected, blended, perfected and preſerved; nor could they be conveyed to the proper organs of ſenſe, though the branches of the olfactory nerves lye almoſt naked, had not provident nature ſupplied theſe parts with humidity, at once to lubricate the parts, and to collect the odoriferous exhalation. 3. Of taſting; no body is ſapid, that does not contain water, or that is not therein ſoluble; and the bodies, which are moſt ſoluble in water, ſooneſt imprint the ſenſe of taſte upon the proper organs: whence, nature has plentifully furniſhed the mouth with water, in the ſaliva or ſpittle, partly to enable animals to diſtinguiſh things the more readily and effectually by this ſenſe: for, a dry tongue can no more taſte, than a dry eye ſee, or a dry noſe ſmell, diſtinctly. Hence, judicious taſters dilute hot liquors, when they truſt to this ſenſe to diſcern their qualities.

§ 147.

§ 147. The active powers of ſubſtances, whether nutritive or medicinal, deleterious or noxious, with regard to the animal oeconomy, would be loſſed without water. And the phyſical effects of bodies upon one another are owing to the ſame cauſe: for, had not theſe ſubjects been, as we find them, ſoluble in water, they could never be conveyed to the deſtined ſcenes of action in animal bodies, nor otherwiſe act upon one another. Thus, ſolid food, were it not ſoluble in water, would prove noxious, rather than nutritive; medicines and poiſons would alike loſe their effects; cauſtic ſalts layed on the ſurface of the body, or inwardly taken would prove inactive and inoffenſive, did they not diſſolve in the humidity, that occurs to them. Salts of all kinds would mix, each with another, without any ſenſible commotion, were they not diſſolved in water. This it is, that determines their motions, cauſes contraſts, ebullitions and efferveſcencies upon the mixture of certain ſalts, either with others of oppoſite natures, with oils and ſpirits or with ſolid bodies.

§ 148. In ſhort, without water, no ſaline, mucous or gummy ſubſtance, much leſs a terrene or metallic body, could be diſſolved; and conſequently, the infinite varity of effects daily produced by ſuch like ſolutions muſt ceaſe. Bodies void of aqueous humidity can neither ſuffer fermentation nor putrefaction. Thus, any body, whoſe juice is moſt ſubject to ferment or putrify, upon being dried and kept ſo, may be preſerved incorrupt for ages; whereas, by the adding of water, or reſtoring its humidity, it becomes ſubject to either. By means of water, many bodies are ſeparated, which otherwiſe muſt remane mixed: Thus, ſalts are waſhed out of aſhes and other earths with water, and by evaporation may be reduced to a dry or cryſtalline form. And by the ſame means, oils or reſins diſſolved in burning ſpirits may be parted. But, water is not onely an inſtrument of parting certain bodies, but alſo that of uniting others; as may be collected from the premiſes;

premiſes; ſince it is plane, that by the interpoſition of this fluid, various ſolutions are performed, and to the ſame cauſe ſtones, brick, and other earthen ware, bones, horns, and ſhells of animals owe their hard and firm conſiſtency, with much of their gravity. In fine, water is a moſt uſeful agent in chemiſtry; for, without it, the material operations of ſolution, extraction, cryſtalliſation, precipitation and humid diſtillation can not be performed: Add to this, the great importance of meaſuring heat with an eaſe and exactneſs unknown to the antients, by the means of water and a thermometer; by which all the degrees, between the freeſing point, thirty two, and two hundred and twelve, the boiling heat of water, beyond which it can not be raiſed, are readily aſcertained for every purpoſe of the curious operator.

§ 149. Having given this general idea of the nature and properties of common water; it may not be judged improper to enter into a more particular examination of this fluid, whoſe juſt uſe and choice is of ſuch great importance in the oeconomy of life.

The trials and choice of ſimple water.

§ 150. Having thus given a general view of the nature and properties of water, it is eaſy to conceive why, and upon what principles, it becomes ſo univerſally uſeful and neceſſary in the works of nature and art.

§ 151. But, as we meet with an almoſt infinite variety of water, from its almoſt unbounded diſſolving faculty; it is neceſſary to point out the diverſity, whence it ariſes, how it is to be diſtinguiſhed, and what kinds of water are moſt fit for the principal purpoſes of life.

§ 152. Nature early teaches us to diſtinguiſh waters by the common teſt of our ſenſes; 1. We look upon no water to be pure or ſimple, that does not upon ſight appear, pellucid or clear, and colorleſs; and the more clear and colorleſs it is, the better we juſtly

pronounce it. Such water upon ſtanding lets fall no ſediment. 2. No water can be thought pure, but ſuch as is perfectly inodorous. 3. No water can be pure, that is not quite inſipid; though ſome inſipid waters are far from pure: moſt terrene or petrifying waters are taſteleſs. 4. The pureſt water makes the greateſt noiſe, when poured out of one veſſel into another. 5. The pureſt water wets ſooneſt and moſt, and feels ſofteſt to the touch. But, though theſe be the firſt trials to be made on water, as the ſenſes differ in moſt men, we are not to truſt ſolely to them; they onely ſerve to guide us to the proper and concluſive trials.

§ 153. Various artificers and ruſtics have certain teſts, by which they prove waters fit or unfit for their ſeveral purpoſes. They commonly diſtinguiſh them into hard and ſoft waters. The hard waters are ſuch as are charged with ſome terrene or ſtony or metalic matter; ſuch as the waters of ſome ſprings and moſt wells or pumps; the ſoft are rain, ſnow, ſome ſprings, moſt rivers, lakes and ponds. The hard are unfit for the watering of plants; whereas the light and ſoft fertiliſe the earth, promote vegetation and nouriſh all vegetables. Wherefore, prudent gardeners, in defect of rain or ſoft river water, expoſe their hard waters ſome time to the air and ſun, in order to ſoften them, by promoting a ſeparation of thoſe terrene or other matters, which rendered them hard. Theſe hard waters are unfit for waſhing or bleaching, brewing, baking, or boiling of food, whether animal or vegetable; being already ſo charged and clogged with terrene and other foregne matters, that they can not penetrate, and reſolve the connection of other bodies, till they be firſt freed from the extraneous impurity. Wherefore, waſhers, bleachers, brewers, bakers, cooks, &c. chooſe the ſofteſt waters for their purpoſes. The firſt commonly know how to ſoften hard, when they can not get ſoft water: For this purpoſe, they infuſe the aſhes of burned vegetables in their

their water, whoſe alcaline ſalt diſſolves therein; by which, the acid in the water is ſaturated, which cauſes a ſpeedy ſeparation and precipitation of the terrene parts, which being, by the acid, ſuſpended in the water, obſtructed its union with ſoap and rendered it, as it is called, hard.

§ 154. Hard waters are the beſt for builders and plaſterers; as they coincide with the intention of giving firmneſs and ſtability to the mortar, by adding more of a ſimilar ſubſtance extremely fine. For want of a due regard to this, we ſee many walls but ill cemented, and plaſter crumbling and mouldering, which made with hard water, would be as firm and durable as ſtone. We have not a more common complaint, than the dampneſs of the walls of our houſes, thoſe built in great cities more eſpecially, where they are ſo negligent or ignorant of this caution, that we frequently ſee them take the waters of ſewers and the common cannals in the ſtreets, charged with ordure and other materials fit for generating nitre, and build walls with them, which never do, nor can thoroughly dry. This I take to be one of the cauſes of fires being ſo eaſily communicated from one houſe to another in our capital.

§ 155. For all the other purpoſes of life, whether for dilution or nutrition, for the boiling our foods of all kinds, eſpecially for the reſolving of horns or bones of animals; for brewing or infuſing of any vegetables; for baking the lighteſt fermented bread; for waſhing of all things; for bleaching of linen, the ſofteſt water is always the beſt.

§ 156. But, no artificer requires ſo great accuracy in the choice of water, as the chemiſt. He uſes it for elixiviation, ſolution, precipitation, lotion or ablution, cryſtalliſation, diſtillation and numberleſs other operations. In which, if the water be not pure, that is, if it contains any thing foregne to his purpoſe, he is liable to endleſs errors and remedileſs deceptions.

§ 157. The waters in the natural ſtate found moſt pure are in the order in which we have ſet

them down in the beginning of this work; to wit, 1. The meteoric or atmoſpheric, as dew, rain or ſnow, gathered with the given neceſſary cautions. This is to be looked upon as a kind of natural diſtillation, whoſe purity, like that of arteficial diſtillation, depends upon the medium, through which it paſſes, and the veſſels, in which it is received. 2. The terreſtrial; as the waters of ſprings, rivers, *&c.* which being but collections of the firſt, differ from them according to the various bodies, on which they have layen, or the ſtrainers, through which they have paſſed.

§ 158. From what has already been offered, relating to the nature and properties of water, the abſurdity of imagining any, that falls under our cogniſance, being perfectly pure and homogene muſt moſt evidently appear: For, in the firſt place, it is hardly to be diveſted of air, without loſing its fluidity, or charging it with ſome other foregne matter; and if it imbibes air, it muſt take in all, that ſuch air is charged with; which may be all the bodies of the terreſtrial creation, in different forms and proportions. However, as bodies muſt be divided to an inconceivable tenuity, to enable them to be ſuſpended in that moſt light fluid, air; ſuch waters as contain moſt air, of all others are found the lighteſt and pureſt: For, ſuch waters, as have their interſtices filled with groſs, heavy, ſaline or other terrene bodies, contain but little air, and are therefore the moſt ponderous. Thus, we find the alcaline ley of tartar, abſurdly called oil, and the acid of vitroil, as improperly called ſo; both being none other than water ſaturated with different ſalts; theſe contain little or none air; as do waters charged with other ſalts or earths, as the waters of ſalt ſprings or the ſea, and petrifying waters, in proportion.

§ 159. Hence, the lighteſt waters moſt readily conceive igneous motion, as well as moſt ſuddenly loſe it. That is, are moſt quickly heated and the ſooneſt

ſooneſt cool and freeſe. It is hard to bring ley of tartar to boil, ſtill harder to bring the heavy acid of vitriol to boil, and in proportion, ſuch waters, as are charged with other groſs matters, whether ſalts or earths. Theſe alſo, when once heated, moſt ſlowly cool, and hardly freeſe. The truth of the laſt obſervation is known to Millers and Fullers in Germany; who are fond of having their machines upon a ſpring or other ſtream of ſuch waters, as are never known to freeſe, though they know not the cauſe. Theſe, I have obſerved to be of the petrifying kind. Of which, the moſt remarkable, that I have ſeen, are, a pretty large rivulet near Aken or Aix la Chapelle, on which there are ſome conſiderable Fulling-mills, and a large ſpring near Malmendy, whoſe waters are turned to the wheel of a mill, for grinding bark for the tanners, in hard weather, to prevent freeſing.

§ 160. As the leſt terreſtrial water is the lighteſt and the moſt readily ſet in motion, ſo it muſt neceſſarily be the moſt volatile. Hence, expoſed to the open air, it is moſt apt to evaporate, and in diſtillation riſes the ſooneſt.

§ 161. The ligheſt water is proved not onely by theſe marks, but by ſtatical experiments; for, ſome waters appear lighter or heavier than others upon the balance. But, to make theſe trials with due accuracy, it is neceſſary to examine the waters to be compared in the ſame degree of temperature, either hot or cold. For, as water is capable of extreme rarefaction by heat, and conſiderable condenſation by cold, nothing can with certainty be determined by hydroſtatical experiments, without aſcertaining by the thermometer preciſely the degrees of heat or cold of the water, at the time of making ſuch experiments.

§ 162. As water then is capable of receiving into it's pores or the interſtices of it's parts, not onely much air, but alſo great variety of ſalts and other terrene bodies, without ſenſibly increaſing it's volume; ſo the water, that contains moſt air is always found

the lighteſt; as that which is moſt charged with terreſtreity muſt be found to contain leſt air and to appear ſtatically the moſt ponderous.

§ 163. Theſe trials may be made various ways. If for example, two or more glaſſes of equal dimenſions be filled with different ſimple waters, ſuch as rain, ſpring, well, river or other waters, all of the ſame degree of heat or cold, and placed under the large receiver of an air-pump; the lighteſt water will ſhew, and part with its air, ſooner and in greater quantity, than the heavier. And the water, which is thus found to contain moſt air, may be pronounced the lighteſt and beſt.

§ 164. This experiment may likewiſe be made by the common Hydrometer, which is a machine, that conſiſts of a round hollow bulb, to one ſide of which, there is placed a round, ſquare or flat index, of three or four inches long, graduated, and oppoſite to it, a weight, to balance the index, is fixed. This may be made of metal, ivory or glaſs, the later of which, I think the beſt, as it wets more freely, and conſequently gives leſs reſiſtance in paſſing through the water, than any poliſhed metal, bone or wood; and the weight, or balance of quickſilver. When this machine is thrown into any liquor, the heavier part of it moſt inclines to preponderate. This being the balance, the index is kept upright, and the bulb ſinks deeper, or riſes higher, in proportion to the levity or gravity of the liquor. And the degree may be noted on the index. The water or other liquor, in which this ſinks the loweſt, is the lighteſt, and ſo on the contrary. But, to compare any two liquors together, care is to be taken, that they be cold or hot in the ſame degree; otherwiſe, the trials will be liable to great incertainty for the reaſons before made obvious. That water, in which this machine ſinks loweſt in the greateſt cold above freeſing, is the lighteſt and beſt.

§ 165. Waters may alſo be compared with ſufficient exactneſs by a common, juſt pair of ſcales: Thus;

Thus; Let a ſtrong glaſs phial be made, to contain about two ounces, with a ſmall mouth, to which a ſtopple is exactly adapted by grinding. Let this phial be filled by immerſion in any water to be tried; then preſſing in the ſtopple, as far as it can go, without violence, let it be quickly dried on the outſide, and exactly weighed. This will ſenſibly ſhew the difference between any two or more waters, of the ſame temperature, compared. That, which is found to weigh the leſt, is the beſt, becauſe the lighteſt, conſequently, the moſt pure, water.

§ 166. The meteoric waters may alſo be compared to the terreſtrial in any particular place or ſeaſon by the following experiment;

§ 167. Let any quantity of pure dry alcaline ſalt, one pound for inſtance, be taken and equally divided into two parts. Let the one be diſſolved, by expoſing it to the open air, and abſorbing the humidity thereof, where it may be leſt ſubject to receive duſt or other foulneſs. Let the increaſe be marked by meaſure and weight. Let it then be evaporated to a dryneſs, and let the proceſs of thus diſſolving and evaporating be repeted ſeveral times. Then, let the ſalt, well dried, as at firſt, be exactly weighed, and the increaſe, if any, be marked.

§ 168. Let the other portion of ſalt be diſſolved in a ſufficient quantity of any water to be compared to the meteoric, noting the quantity with exactneſs, that the proportion of this water to that abſorbed from the atmoſphere, be with due accuracy aſcertained. Let this ſolution like the former be carefully evaporated to a dryneſs, aud the proceſs of ſolution and evaporation be repeted in this, as in that, and at laſt, the ſalt dried, as at the firſt. Then, let it be weighed and its increaſe accurately noted. Whatever either has increaſed in weight, it muſt have gained it from the water, in which it was diſſolved; if the experiments were performed with care and cleanlineſs. And upon compariſon the different purity or impurity of the ſolvent,

with its proportions, will be exactly known. The portion of ſalt, which received the greateſt increaſe, or otherwiſe ſuffered the greateſt change, denominates the moſt impure water.

§ 169. By this means alſo any two terreſtrial waters may be compared.

§ 170. This may be a more certain method of determining the quantity of ſolid contents diſſolved in any water, than ſimple evaporation by itſelf. For, many particles of terrene matter may be ſuſpended, ſo united with the water, as to fly off with it in vapor; whoſe connection with that fluid may be ſo broken, by the interpoſition of this ſalt, that they may be more eaſily ſeparated; ſo that the water may be purely exhaled and leave its earthy companion, as well as ſome portion of its acid, mixed with the alcaline ſalt.

§ 171. The chemic art has, as yet, found out no means, by which terrene bodies may be diſſolved and ſuſpended in water, but by the interpoſition of ſalts, and theſe chiefly acid. It is true, BECHER tells us of a volatile mineral ſpirit, that bears no mark of acidity, but is purely inſipid; which nevertheleſs, is found capable of diſſolving, not onely earths, but metals. This our learned author diſcovered in blew clay. And, from thence, ſays, he was able to extract it by diſtillation: For, he informs us, that it tranſcends the helm with the ſlighteſt heat, and in an advanced degree, may be diſtinguiſhed from the water contained in the clay, by its diſtilling in little ſtriae or venes, like vinous ſpirits, along the inſide of glaſs diſtilling veſſels.

§ 172. If the exiſtence of this ſpirit were once fairly proved, we might eaſily account for the almoſt infinite impregnations of water with metallic and other earthy bodies, which daily occur to us. We might alſo conceive, whence the extraordinary medicinal virtues aſcribed to certain newly diſcovered ſprings of inſipid water, which in time are found quite effete and uſe-

uſeleſs, might ariſe. But, why this ſpirit, whoſe exiſtence and power, I do not pretend to queſtion, ſhould be diveſted of the acid character entirely, is the doubt, in which I heſitate. That it is extremely volatile, I agree; for, we often ſee it fly off in the boiling and leave the water milky, with the precipitating earth, which it had before ſuſpended. Yea, fly off upon ſtanding in the open air, ſo as to let go the earth and leave the water, which it had before rendered terrene and hard, ſimple and ſoft. And, that it can not be well collected without ſuch a quantity of ſimple water to dilute it, as muſt render it inſipid, I can, without much difficulty, conceive. But, that it is no more, than the univerſal acid, more pure and exalted, than we commonly extract it from other minerals or metallics, I am induced to believe, from the following, among other, conſiderations;

§ 173. The moſt inſipid terreſtrial waters to be met with, that contain any terrene or metallic matters, part with them upon the addition of fixed alcaline ſalts; which, by the rules of chemiſtry and natural philoſophy, is thus explaned; The terrene or metallic body in the water, was diſſolved and ſuſpended therein, by the interpoſition of a body, that had a ſtrong attraction with theſe ſubſtances; thoſe, that have the ſtrongeſt attraction, we know of, with ſuch ſubſtances, are the ſeveral kinds of acids; all theſe, in different proportions, modifications and manners, diſſolve all metals, metallics and other terrene matters. When then, an alcaline ſalt is thrown into ſuch a ſolution, or a water, with any ſuch matter thus impregnated, the effect is a breach of the former combination and the production of a new one; which is accounted for in this manner, by our modern ſyſtems of Chemiſtry and Philoſophy:—The mutual attraction, which is judged to ariſe from the ſimilarity or affinity of bodies, betwixt the acid and the earthy bodies cauſed a diſſolution and union of them. This union is broken upon the adding a third body, which has a

ſtronger

ſtronger attraction to one or other of the diſſolved bodies, than they had to each other. This is the alcaline ſalt, which has the moſt powerful attraction to all acids. As ſoon then, as it is thrown into any water, I have yet ſeen or heard of, which is impregnated with any terrene matter, ſo ſoon, the mixture grows turbid and lets fall a ſubtil powder, by the chemiſts called, a precipitate, or magiſtery. The evident cauſe of which is the more powerful attraction between the alcali and acid, than between the terrene body and the acid; whence, a new combination ariſes, a neuter ſalt, from the union of the acid and alcali, a mixture no longer capable of diſſolving or ſuſpending metals, metalics or mere terrene bodies; whence, all ſuch, from their ſpecific gravity, preponderate and precipitate.

§ 174. Upon this principle it is, that we diſcover a great variety of bodies in waters merely by the addition of other bodies; and at laſt, determine the nature of the acid, in which the firſt and all the ſucceding bodies were diſſolved.

§ 175. The order of this attractive power, as it is demonſtrated in Chemiſtry, is as follows;

§ 176. 1. All metallic bodies diſſolved in acids, the mineral acids eſpecially, are precipitated, firſt, by all the abſorbent earths; ſuch as lime, chalk, crabs eyes, &c. When the ſolution is ſaturated with theſe earths, it then bears no relation to the metallic ſubſtances; they are precipitated, and the liquor is charged onely with theſe earths. Then, ſecondly, theſe earths are all precipitated by volatile alcalies; ſuch as ſalt or ſpirit of blood, urine, hart's horn, or any animal body. And then the reſult is a terrene magiſtery at bottom, and the liquor is charged no more with earth, but with a kind of ſalt ammoniac; that is, a volatile alcali ſaturated with a mineral acid; if it be the acid of ſea ſalt, it will be true ſalt ammoniac; if the acid of nitre, a ſalt partaking of the nature of ſalt ammoniac and common nitre; if the acid of vitriol,

or

or the univerſal acid, the ſal ammoniacum ſecretum of Glauber. Thirdly, The connection of any of theſe is broken, by adding what has ſtill a ſtronger attraction with any of theſe acids, than the volatile alcali had. This is found to be a fixed alcali; upon the mixture of which with the former ſolution, an union ariſes between it and the acid; whereby, the volatile alcali being ſet at liberty, by its volatility, makes its eſcape in the open air. The reſult of which is another kind of neuter ſalt, differing according to the nature of the acid, as the ammoniacal ſalts were found in the laſt preceding obſervation. Thus, for example, an union of a fixed alcali with the marine acid, produces a ſalt, like ſea ſalt; with acid of nitre, ſalt petre, or common nitre is regenerated; with the vitriolic acid, arcanum duplicatum or tartar vitriolate is produced. The moſt powerful attraction then in theſe ſubſtances lyes between the acid and the fixed alcali, the ſecond between the acid and the volatile alcali, and ſo of the reſt.

§ 177. 2. But, to be more particular; We have already ſayed, that the metals, as well as earths, are ſoluble in the mineral acids, which is ſuppoſed to be cauſed by attraction; of which there are different degrees between the different metals and acids, as determined by chemical experiments; the knowledge of which tends greatly to facilitate our examinations of water and to give us clear conceptions of the compoſitions, as well as decompoſitions, that are daily produced by nature and art in this way. As for Example;

§ 178. 3. The more noble metals, as gold and ſilver are leſs attracted by the ſeveral acids capable of diſſolving them, than the baſer metals; theſe are leſs attracted than the abſorbent earths; theſe earths, leſs than the volatile alcalies, and the volatile ſtill leſs than the fixed; ſo that theſe precipitate each other in the following order; — ſilver diſſolves in the acid of nitre, commonly called the ſpirit of nitre, vulgarly

aqua

aqua fortis; ſo do mercury or quickſilver, lead, copper, iron, zinc; abſorbent earths, and volatile and fixed alcalies. If then to the ſolution of ſilver, diluted with diſtilled water, you add quickſilver, the ſilver will be precipitated and the quickſilver diſſolved. If more quickſilver be added, than the ſolvent is capable of diſſolving, then a ſhrub-like concretion of cryſtals, called Arbor Dianae, or Philoſophorum, Diana's or the Philoſopher's tree, is produced. If to the ſolution of quickſilver, you add plated or granulated lead, the quickſilver will be precipitated and the lead diſſolved; If to this ſolution of lead, thin plates, wire or filings of copper be added, the lead will fall to the bottom in form of a white powder, and the copper will diſſolve and give a ſky blew tincture to the ſolution; if to this ſolution, clean, fine wire or filings of iron be immerged, the acid will attack the iron, and quit and let fall the copper in its proper form; If to this ſolution of iron, granulated or filed zinc or ſpelter be added, this will be diſſolved, and that precipitated; If to this ſolution, an abſorbent earth be added, the ſolvent will quit the metalic and diſſolve the terrene body; this terrene ſolution, will be precipitated, upon the addition of a volatile alcali; this volatile alcali will be ſet at liberty, and fly off in its original ſhape and form, upon the addition of a fixed alcali, and the acid of nitre thus recovering its alcaline baſe is again by evaporation reſtored to its priſtine form and quality; common nitre or ſalt-petre. The attraction then ſtands in an inverted order to that which we have ſet down for theſe precipitations or decompoſitions. Thus, the ſtrongeſt attraction is between the mineral acid and the fixed alcali; the next, between the acid and the volatile alcali; the third, between the acid and the abſorbent earth; the fourth, between the acid and the zinc; the fiveth, to the iron; and ſo to the reſt.

§ 179. The like order holds good in the attraction between the vitriolic acid and theſe bodies; and as this is the moſt common acid, and that, in which we find

find moſt metals and metallic ſubſtances diſſolved in the bowels of the earth, as well as ſtones and earths themſelves, I ſhall ſet it down and ſhew the reſult of the various impregnations and decompoſitions with it produced.

§ 180. To this acid, we owe a great variety of compoſitions and combinations of bodies in nature, as well as by art. The ſubſtance, with which it has the ſtrongeſt affinity known, is the inflammable principle of bodies, that, to which vegetable and animal bodies owe their oily or combuſtible quality, and to which metals are indebted for their luſtre, ductility, malleability, *&c.* For, without it, they are all but calces, as the chemiſts call them, incoherent earths; as by reſtoring it, they regain their fuſibility, ſplendor, ductility, malleability, *&c.* When theſe two principles, the univerſal acid and the Phlogiſton, in an highly ſubtiliſed ſtate, are brought into contact, they moſt powerfully attract each other and form that concrete, called ſulphur or brimſtone. Here, is its ſtrongeſt and firſt attraction.

§ 181. The ſecond, is with fixed alcalies; with the mineral fixed alcali, the baſis of ſea ſalt, it forms that concrete, called Glauber's ſalt, from the inventer's name *; with the vegetable fixed alcalies, this acid forms tartar vitriolate, arcanum duplicatum, or ſal polychreſt; for, they are all one, when rightly prepared and perfectly purified.

§ 182. The third, is with volatile alcalies; with which it forms a kind of ſal ammoniac, firſt deſcribed by Glauber and taking his name.

§ 183. The fourth is with earths, ſome kinds of which it holds intimately diſſolved in the form of a

* This ſalt is common in many waters; there is no purging water without it, in one form or other: It paſſes with many, if not with moſt, of our writers, for nitre, from the reſemblance of form. Even the great Dr. LISTER took it for nitre; but, well obſerving the difference, gave it a diſtinguiſhing epithet, though of no ſignification; he called it, Nitrum calcarium, in which he is followed by many.

ſalt,

ſalt, as alum; whileſt with thoſe, called abſorbent eſpecially, when diluted in a ſufficient quantity of water, it forms another concrete; which, while diluted, it ſuſpends; otherwiſe, it lets fall that ſubſtance, which is called Selenites, Aphroſelenus, and by ſome, Sal Selenites, from its reſemblance to a ſalt in every thing, but ſolubility, after it is once formed. To this combination, it is more than probable, Gypſum or Plaſter of Paris, Talc, Muſcovy glaſs, Spar, *&c.* owe their origine. Many waters are charged with ſelenite; as thoſe of Pyrmont, Spa, *&c.* and others, with different other ſtoney or earthy matters, as all the petrifying and other hard waters. To this quality, the obſtructing and fouling of the glands, particularly that, called the Thyroide, which brings on the ſwelling under the chops, called Bronchocele, ſo common at the feet of the Alpes and other mountanes in Switzerland; where the waters of the aqueduct of Arcueille are much drank, in Paris; among thoſe, who drink much of the wells in Rheims, or of the Pouhon, at Spa; as all the common people do, to whom it ſerves for ordinary beverage.

§ 184. The fiveth degree of attractive power of the univerſal acid is with iron. Hence, the aptneſs of this metal to corrode or ruſt in the open air, by attracting this acid. Hence, the ſlatey concretions found about mines, thoſe of coal particularly, which expoſed to the air, moulder into duſt, which taſtes, auſtere, ſubacid or vitriolic, containing iron; which, with this acid, forms vitriol of iron, green copperoſe. From an union of this acid with iron and the inflammable principle, phlogiſton, that concrete called, by the greeks πυρίτης, Pyrites, that is, the Fire-ſtone; either becauſe it ſtrikes fire by percuſſion, like a flint; or becauſe, expoſed to the air in heaps, it conceives fire and burns. This conſiſts of ſulphur and iron, with abundance of the acid, as appears by chemical analyſis. The concentrated acid of vitriol attracts the humidity of the air; by which, ſuch an agitation,

ſuch

ſuch an attrition of the parts is excited, as produces heat, and in this concrete, kindles the inflammable principle into actual fire. Hence, the Pyrite becomes the chief, if not the ſole, cauſe of ſubterranean heat and fire; by its means, ſome waters are heated, others impregnated onely, and others impregnated and heated; As ſhall be ſpoken to more at large, in treating of the mineral waters.

§ 185. The ſixth degree of attraction is with copper. This metal is ſoluble by all the ſalts. It is ſo, by this acid, and with it forms the natural Aerugo, or verdigriſe, found in the mines, as alſo blew vitriol and other ſimilar concretes. Many waters are ſtrongly charged with copper by means of this acid; As in divers mines in Hungary, Germany, and in one in Ireland, from whence the copper is ſeparated by means of iron.

§ 186. Its laſt and remoteſt degrees of attraction are with the noble metals; but, as it does not diſſolve them, without ſome particular management of art, which is not found in nature, it is foregne to our purpoſe to do more than glance at them in this place.

§ 187. Here, we have ſhewn what bodies are moſt likely to be diſſolved in water, by means of this acid, and how. Now, to ſhew partly how they may be diſcovered, or ſeparated, and partly to prove and illuſtrate our rule, let us invert the order, and ſee the reſult.

§ 188. Let us begin with one of the pure or perfect metals. If ſilver be diſſolved in the acid of nitre, it may be precipitated, with the acid of ſalt, in the form of a magiſtery, which when fuſed and cooled, becomes an horney ſubſtance, called Luna cornua. It may, in like manner and form, be precipitated, by the vitriolic acid. If to the magiſtery, thus precipitated, a ſufficient quantity of this acid be added, it will be rediſſolved in it. So ſhall a ſolution of ſilver in the acid of vitriol be obtained. *

§ 189. If, in this or the former ſolution, thin plates, wire, or filings of copper be immerged, the ſilver will be

* STAHL de vitriol. elog.

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precipitated, in bright, white granules, in proportion, as the copper is attacked by the acid, and takes its place. This givs a ſolution of copper, and yields blew vitriol by cryſtalliſation, when the vitriolic acid is uſed.

§ 190. If to this ſolution of copper, wire, thin plates, or filings of iron be added, that moſt ſoluble metal will be forſaken by the acid, which engages and diſſolves the iron. Thus, copper may be extracted in its pure, natural form, from any waters impregnated with it. This has been imagined a tranſmutation; becauſe copper is found, not onely in the place of the iron, but if the ſolution of copper be duly diluted, the concretion of copper, will be found of the preciſe form and make of the piece of iron, whoſe place it took. This is but a miſtaken notion, like many others, that prevale, for want of a competent knowledge in chemiſtry; For, this is no more, than a precipitation of copper, and a ſolution of iron, upon the principles layed down. The proof of which appears by evaporating the ſolution of iron, whence the copper was precipitated: For, by this means, the iron will be found in the form of copperoſe, if the firſt ſolution was made in the vitriolic acid:—An uſeful hint for the Iriſh copper miners, who throw away their water thus charged with iron, as they till lately did thoſe impregnated with copper.

§ 191. If, to this ſolution of iron, granulated zinc be added, the acid will quit the iron, and diſſolve the zinc; which ſolution, if made by the vitriolic acid, will give white, as the preceding gave green, vitriol or copperoſe.

§ 192. If to this ſolution, well diluted, abſorbent earths be added, the zinc will be forſaken by the acid, which encounters and diſſolves the earth; but, if the vitriolic acid be uſed, and it be not well diluted, a ſelenite will at the ſame time be formed, and precipitate alſo. This will be an hard, and petrifying water.

§ 193. If to this ſolution of any abſorbent earth, or ſuch like charged and hard water, any volatile alcali be added, a milky opacity enſues, and the ter-

rene parts are ſoon after precipitated, leaving the water impregnated with Glauber's ſecret ſalt ammoniac; which may be extracted by cryſtalliſation.

§ 194. If to this ammoniacal ſolution, a fixed alcali from the mineral kingdom be added, the volatile alcali will be ſet at liberty, by the union of the acid with the fixed alcali, to which it has the ſtrongeſt attraction; the reſult of which union is the expulſion of the volatile alcali, and the production of Glauber's ſalt, the Nitrum calcarium of LISTER and others.

§ 195. If to this ſolution of this neutral ſalt, or to a ſolution of Epſom or Glauber's ſalt, a fixed vegetable alcali be added, the mineral alcali will be precipitated in the form of a white magiſtery, the magneſia alba of the ſhops, from the ſtronger attraction of this acid to the vegetable, than to the mineral, fixed alcali. This liquor then freed from the magneſia alba, contains a neuter ſalt of an other kind, which it yields upon evaporation in cryſtals; Tartar vitriolate, arcanum duplicatum, or ſal polychreſt. This ſhews the manner of producing theſe like compoſitions, the degrees of attraction or affinity, theſe different ſubſtances bear to each other. And nothing can contribute more to a true knowledge of the nature of all ſorts of water, than being perfectly acquainted with theſe rules. But, though it may, in ſome ſort, be thought foregne to our purpoſe, at firſt ſight; I muſt procede to prove my firſt poſition with regard to the attraction of the acid and the phlogiſtic principle.

§ 196. The laſt mentioned neuter ſalt appears to conſiſt of a vegetable alcaline baſe and the vitriolic acid; as the laſt but one appears compoſed of the ſame acid, with the mineral fixed alcali to its baſe. Now, if to either of theſe, a ſubſtance be added, which has a ſtronger attraction with either the alcali or acid, than they have to each other, a decompoſition or diſunion of this concrete, and a third ſubſtance, differing from both, will be produced. This is done by fuſing Glauber's ſalt by itſelf, or tartar vitriolate,

which is not by itſelf fuſible, with the addition of a little fixed alcali: If to either of theſe in fuſion, be added any vegetable or animal body, burned in a cloſe veſſel, or ſo as the air had none acceſs, ſuch as charcoal or ivory black, and then fuſed together cloſe covered for a while; the univerſal acid will quit the alcaline baſe to attract and unite with the phlogiſton, with which it conſtitutes another kind of body, which is ſulphur: For, by pouring water upon the black or dark brown maſs, which is the reſult of this mixture and fuſion of theſe neuter ſalts, with bodies replete with the pure inflammable principle, as charcoal, &c. a ſolution of ſulphur, by the means of the alcaline ſalt, which alone could render it ſoluble in water, is produced. Thus, water may be impregnated with ſulphur; not otherwiſe: For, water can not be actually, or ſubſtantially, charged with ſulphur, without the interpoſition of an alcali. Hence, the abſurdity of thoſe, who contend for the exiſtence or ſolution of ſulphur, where no ſalt or a neuter ſalt onely, not an alcaline one, is found in the waters; or what is ſtill more inconſiſtent, who look for ſulphur in thoſe waters, in which an heavy acid predominates, muſt appear; as it muſt alſo from the following conſiderations, which, at the ſame time, prove ſulphur generated by the above union of the acid and phlogiſton.

§ 197. 1. The above maſs ſmells ſtrong of ſulphur, though each ingredient before mixture, was ſcentleſs.

§ 198. 2. It grows moiſt and partly flows in the air, and diſſolves alſo in water, to which it gives a yellow color, ſtrong ſmell, and bitter taſte, and the quality of tinging ſilver firſt yellow, and then of all the colors.

§ 199. 3. If to this ſolution, purified by ſtraining, as much of any acid be added, as may ſaturate the alcaline ſalt, now in ſome degree ſet at liberty, by the vitriolic acid's quitting it, to unite with the phlogiſton; If, I ſay, to a pure ſolution of this maſs in wa-

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ter, any acid be added, it will ſaturate or neutrate the alcali, and in proportion, as it produces this effect, it renders the liquor incapable of diſſolving ſulphur, or of keeping it ſuſpended when diſſolved; whence, it precipitates in form of a white powder, called magiſtery, milk, or precipitate of ſulphur. This precipitate dried and fuſed gives common brimſtone. Sulphur is ſoluble in no fluid but oil, without the interpoſition of an alcali. The later being fuſed with ſulphur, gives a ſubſtance analogous to this, called hepar ſulphuris, liver of ſulphur, from its liver color. This is ſoluble in water, ſo is crude ſulphur in lime water or any alcaline ley; and this is the onely method known, by which ſulphur is ſubſtantially diſſolved in water. And this ſolution is deſtroyed and the ſulphur precipitated by acids of all kinds, as above.

§ 200. From whence * we may, as truly, as reaſonably, conclude, that ſulphur is generated by the means mentioned; that, in this manner, it is rendered, from inſoluble, ſoluble in water; that by acids, it is precipitated, and conſequently can not ſubſiſt in a ſtate of ſolution in any water, that is not charged with an alcali, much leſs in a neuter water, and leſt of all, where any acid predominates. In what manner ſulphur is contained and found in the waters of Achen or Aix la Chapelle, and why there is, and can be, none in thoſe of Bath, contrary to the received opinions, ſhall be explaned in treating of theſe waters apart. But, let this be here eſtabliſhed as an axiom, that ſulphur is not by itſelf ſoluble in water, and can be diſſolved therein by none other means known, than thoſe of alcaline ſalts or earths; whence, it becomes precipitated, when thus diſſolved, by every thing, that tends to neutrate the alcali; eſpecially, by the predominancy of acidity of any kind.

* § 196, 197, 198, 199.

§ 201. Water, by the means of acids, may be, as we often find it, impregnated with an extreme variety of mineral bodies; as divers metals, metallics, ſtones, earths, &c. in different manners and proportions; without imparting any thing remarkable to the ſenſes. Then, it paſſes for ſimple, pure water; but, the deception is diſcoverable by the rules here layed down. Thus, all bodies diſſolved in water, by means of an acid, may be precipitated and diſcovered by alcalies; whileſt, on the contrary, ſuch bodies, as are diſſolved in water, by the interpoſition of alcalies, are precipitated and determined by acids.

§ 202. Various foſſil bodies diſſolved in acids may be precipitated by other acids. Thus ſilver, though it may, by different artifices, be diſſolved, in ſome proportion, in the acids of vitriol and ſea ſalt; yet, either of theſe acids dropped into a ſolution of ſilver, in its proper ſolvent, the acid of nitre, will cauſe a precipitation of the metal in white clouds, which ſettle in a grumous ſediment. Hence, this ſolution of ſilver is uſed in the trial of waters: For, if dropped into any pure water, it makes no change, as before obſerved*; but, in water charged with the vitriolic acid, or that of ſalt, or ſalt in ſubſtance, a blewiſh cloud and white precipitate is inſtantly produced.

§ 203. The ſame holds true of quickſilver alſo; which diſſolves difficultly in the ſaline and vitriolic acids, but readily in that of nitre: Yet, a ſolution of it, in the laſt acid, is precipitated by ſea ſalt, and its acid, as well as by the various other ſubſtances ſet down in the preceding rules. Whence, it is uſed in the trial of waters for the ſame purpoſe, as ſilver.

§ 204. Lead diſſolved in the acid of nitre, or in diſtilled vinegar, is precipitated by waters, charged with theſe acids, as well as with abſorbents and alcalies. Whence, ſuch ſolutions, the latter eſpecially, are uſed to the like purpoſes with the preceding. Theſe† may

* § 178. 3.

† § 202, 203, 204.

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be conſidered as exceptions to the ordinary notions of the attractions of ſolvents and ſolvends: For, though quickſilver, ſilver, lead, regulus of antimony and tin do not ſo powerfully attract the acid of ſalt, when each are in the aggregate ſtate, as to effect a complete ſolution; yet, any of theſe, being firſt divided or diſſolved by any other ſolvent, inſtantly attracts and is attracted by the acid of ſalt, from which it is not to be ſeparated by any other acid; whence, the attraction may here be deemed the greateſt. Thus, quickſilver diſſolved in any other acid, upon the interpoſition of ſea ſalt, quits the firſt ſolvent, unites and ſublimes with the acid of ſea ſalt; and ſilver and lead, diſſolved in other acids, are precipitated by this of ſea ſalt; yet, not ſo as to become perfect magiſteries; they conſtitute the horn-like, fuſible, and volatile ſubſtances, called Luna cornua, or Saturnum cornuum.

§ 205. From the foregoing rules and obſervations, uſeful methods of examining waters may be collected. Suppoſe, for example, we take any water, whoſe purity we would prove, or whoſe compoſition we would explore; after comparing it by the balance, hydrometer, pneumatic machine or air pump, by the ſolution of alcaline ſalts in air and water, &c. to the pureſt water, that can be procured, as before directed*; let us procede to further experiments, upon the principles of ſolution and precipitation before layed down, taking in ſome from the art of dying, with which, as the ſimpleſt, we may properly begin. The effects of the various dying matters, uſed for theſe purpoſes, are to be determined by experiments, firſt in ſimple water, then in thoſe, that are variouſly impregnated with acids, with metallics or minerals, with abſorbents, alcalies, &c. noting the difference, and examining the cauſes, as well as effects.

§ 206. 1. Chemical experiments teach us, that all the blew flowers of vegetables, or their coloring juices,

* § 92, 93, 1. & ſeq.

are not changed, further than by dilution, upon mixture with pure water; whereas, with acids, they are changed to a red, and with alcalies and abſorbents, to a green color.

§ 207. To this general rule, however, ſome exceptions ſtand; ſome acids charged with certain abſorbents, as the vitriolic acid, with that earth, that produces alum, with certain metals and metalics, as iron, lead in diſtilled vinegar, not in the acid of nitre, change them into a green. Wherefore, the foregoing experiments of changing the juice or infuſion of blew flowers green, are not to be relied on, before they are confirmed by other collateral proofs.

§ 208. If, for example, any water turns green, upon mixture with ſirup of violets, we are not to conclude this change wrought by an alcali, until we have tried a portion of the water with an alcali: For, if it was an alcali, that cauſed the green color, adding an alcali to the water will work no change in it. Whereas, it will otherwiſe cauſe a commotion or precipitation of the terrene or metallic matter, which was the true cauſe.

§ 209. 2. This ambiguity is partly cleared up by the juice of tournſol, or paper died blew with it. The color of this is turned to a pale red, by acids, but preſerved, heightened, or reſtored by alcalies. Hence, we conclude, water that makes no change in ſirup of violets is neither acid nor alcaline; that, which turns red with ſirup of violets, or tournſol, contains an acid; that which turns the ſirup green, and exalts the color of the tournſol, or changes or reſtores it, from red to blew, is impregnated with an alcali.

§ 210. 3. Red roſes dried, yield in pure water a pale red or Burgundy wine-color. This is highly exalted by acids, eſpecially the mineral acids, in certain proportions; particularly by the acid of vitriol. Whereas, it turns to a pale yellow or goſling green with alcalies, and with ſolutions of iron, a compound color of a blewiſh tincture with a yellow, a kind of a dark

dark olive color, is produced. To this claſs may be added the juices or ſirups of red flowers, ſuch as red poppies, cloves, &c. the juices of red cabbage, red or bloody dock, red betes, and the like, which are not altered or exalted in color by acids, but changed to a green by abſorbent earths and alcalies.

§ 211. 4. Rubarb in pure water gives a bright yellow tincture; which acids render rather more pale; but alcalies tinge to a high red; whereas, ſolutions of iron produce much the ſame color with this infuſion, as with that of roſes.

§ 212. 5. Campechy dying wood, or logwood, gives a bright red or deep Burgundy wine-color to pure water. This is heightened to a deep crimſon by alcalies; to a deep purple, with blew vitriol; to a deep mazarine blew, with green vitriol; all which colours are deſtroyed by acids: The bright red is reduced to ſomewhat of a tawny.

213. 6. Cochinelle is an inſect, with which, by the means of the acid of nitre and tin, the modern ſcarlet dye is produced, and from which the beautiful ſcarlet pigment, called carmine, is made. The judicious dyers chooſe the water fitteſt for their purpoſe, by this drug. In pure water it yields an high red tending to the crimſon hue. This is heightened by alcalies; but brought to the ſcarlet hue by acids, and if they contain metalics or abſorbent earths, the coloring matter is precipitated.

§ 214. 7. Oak bark, leaves, juice, or excreſcences, and all the aſtringent vegetables, give but their native coloring matter in pure water. Alcalies render ſuch infuſions turbid, by cauſing a kind of precipitation of the abſorbent, or aſtringent, terrene ſubſtance of ſuch vegetables diſſolved in the water; which it likewiſe tinges of ſome ſhades of green, upon ſtanding. Acids, on the contrary, reſtrain the tinge, except in red flowers, and in ſome, precipitate or deſtroy it. The ſolutions of iron, in vitriols, &c. ſuffer that kind of precipitation by this very ſubtil, ſtyptic earth, which

produces a blew, or as the tincture and ſolution are ſtronger, is heightened to the extremity of blew, which is black; what we call ink. Wherever any ſhade of this color is produced by the infuſing any aſtringent vegetable in any water, we pronounce it chalybeate, or ferrugineous, a ſteel or iron water, and ſo procede to further trials upon that head. This color is totally deſtroyed by reſtoring both the precipitating coloring matters, the aſtringent vegetable earth and the iron, to a ſtate of ſolution, by the means of any acid. And, upon deſtroying or ſaturating this acid, with an alcali, the black color is again reſtored; not quite ſo perfect, becauſe more compound; being an other different precipitation of the iron, cauſed by the alcali.

§ 215. 8. Alcaline ſalts, volatile and fixed, in a concrete or liquid ſtate, make no alteration, ſuffer onely ſolution and mixture, in our pure water. But, in waters, charged onely with acids, an ebullition and contraſt, with the dry ſalts eſpecially, will ariſe; in waters, by means of acids charged with any foſſil body, a precipitation, which examined ſhews the nature of the matter precipitated, and a neuter ſalt, which demonſtrates the properties of the acid, are produced.

§ 216. 9. If the water contains copper, the volatile alcalies, as ſoon as they have ſaturated the acid, that held it diſſolved, will ſeiſe and diſſolve it, and produce a beautiful ſaphirine color.

§ 217. 10. Soaps ſerve to prove the purity and quality of the water.* Soaps readily, equally diſſolve in pure water; in hard, or highly charged waters, ſlowly, difficultly; and ſoon after ſeparate into grumous coagulations, the acid in the waters more ſtrongly attracting the alcali, than the oil did in the ſoap; whence, the ſoap is decompoſed; that is, the alcali quits the fat or oil in the ſoap, to unite with the acid in the water, with which, after ſeparating and precipitating the terrene matters, it forms a ſalt, as before

* § 101.

explaned,

explaned,* according to the nature of the acid. For these experiments, I choose a solution of soap made in brandy, which mixes with the water, without that commotion occasioned by fire or agitation, which may otherwise be necessary, and which might greatly alter the nature of the water before the soap could be dissolved in the common manner of making a lather.

§ 218. 11. Some use, what they improperly call oleum calcis, oil of lime, to try waters. This is a solution of lime or chalk in the acid of sea salt, which is the mother or bittern. It may also be made with the acid of nitre. But, we meet with very few waters, in which this will cause any change by the preceding rules: We may observe, it will itself be decomposed and precipitated by alcalies; as it will precipitate metals, in some strong solutions. It is likewise precipitated in a saline form, that of the selenite, by the vitriolic acid.

§ 129. 12. If we find by the preceding trials,† room to apprehend a water contains any thing alcaline, we try it with acids, which by an ebullition with it, prove our apprehensions just, and teach us to judge from the salt produced by the saturation, what alcaline substance it contains.‖ For these trials, we begin with the milder vegetable acids, either simple, as juice of oranges, lemons, &c. or fermented, as vinegar, &c. and that either simple, or distilled. From these, we gradually procede to the stronger, the mineral acids, those of salt, nitre, and vitriol. If we find the milder acids cause an ebullition, we may conclude, the stronger must. These are the fittest to determine the nature of the salt in the water; because, the effect of their combinations with alcaline salts are best known, and easiest demonstrated. Though the salt produced by the union of fixed alcalies with vinegar is known by its foliated form, whence called whimsically Terra foliata tartari, the Foliated earth of tartar;

* § 176, 181. † § 206. 1. 209. 2.
‖ § 176, 181.

in

in our ſhops, as inexpreſſively, ſal diureticus, the diuretic ſalt; as alſo by its fuſibility, volatility, and aptneſs to liquefy in the open air; qualities, which diſtinguiſh it from moſt other neuter ſalts, but are found in an inferior degree in that prepared with the mineral, to that prepared with the vegetable, fixed alcali. In like manner, the ſalt produced by ſaturating an alcaline water, with a ſolution of tartar, would be known by its ſolubility and the figure of its cryſtals, if it bore any analogy to tartarus tartariſatus or ſolubilis; a ſalt ſo called, compoſed of a fixed alcali ſaturated with the creme or cryſtals of tartar.

§ 220. 13. A ſolution of alum in ſimple water is uſeful in the examination of other waters. Alum conſiſts of a peculiar abſorbent earth diſſolved in the univerſal or vitriolic acid. This added to pure water, ſuffers no change, but ſolution. But, if the water contains any thing, that has a ſtronger attraction * to either of the conſtituent parts of alum, than they have to each other, a diſunion of theſe parts will be occaſioned and a new combination produced; each of which examined apart gives us intimations of the compoſition of the water. As for example; If a ſolution of alum, upon dropping into water cauſes white clouds and a precipitation, the inſtilling of the ſolution may be repeted till no more cloudineſs ariſes, or precipitation is cauſed by the mixture. Then, it is to be preſumed ſaturated. The precipitate being ſeparated, will be found upon examination to be the earth of the alum, whileſt its acid has formed an union with an alcaline ſalt and produced that concrete, which this acid is found to form with alcaline bodies.† But, it muſt be remembered, that in ſome caſes, the acids perform ſuch a precipitation, where the ſolution is metallic. ‖ Thus, the ſolutions of ſilver and lead are precipitated by the vitriolic acid in the alum. Theſe precipitates are diſtinguiſhed from the former by this; that of ſilver readily fuſes and ſoon after

* § 118, 119, 120. † § 194, 195. ‖ § 207, 208.

flies

flies off, if continued over the fire. If it be ſuffered to cool, it yields an horney ſubſtance, called, Luna cornua. That of lead will yield ſimilar appearances; and each may be reduced to its priſtine metallic form; the one by fuſion with the black flux, ſoap, &c. the other, with the addition of a little oil or fat or charcoal duſt, will fuſe into its priſtine form, the metallic properties, loſſed in the ſolution, being reſtored with the phlogiſtic or inflammable principle.

§ 221. 14. The metallic ſolutions in different acids may all contribute their part in the examination of ſimple, as well as mineral waters, upon the principles of attraction or affinity, as before layed down;* Of each of which in their order.

§ 222. 15. Quickſilver diſſolved in the acid of nitre diluted with purified water; or the ſolution evaporated to a dryneſs, or to cryſtals, and the dry maſs, or the cryſtals diſſolved in diſtilled water, exactly noting the proportion in a given quantity of the fluid; This is one of the boaſted ſecrets, one of the much famed drops, of one of our quacks of the firſt magnitude; As any one may prove by the following experiments.

§ 223. 16. By the different degrees of attraction obſerved between other bodies and the nitrous acid, greater than between that and the quickſilver, it is eaſy to judge how many different ſubſtances, ſuſpended in water, may cauſe a precipitation therein, upon the addition of this ſolution.† Quickſilver in this form is precipitated, not onely by the various metals and metalics in the cited ſection ſet forth, but by all abſorbent earths, by alcalies, volatile and fixed; and theſe, mineral, as well as vegetable; but particularly by ſea ſalt and its acid. Hence, waters charged with theſe ſubſtances muſt precipitate the mercury in ſuch a ſolution, whenever it is dropped into them. But, they produce different colors which diſtinguiſh them; in chalybeate waters it is firſt white, then ſuddenly changes to a lemon color, or deeper yellow; the ſame

* § 175, 176, 177, and ſeq. † § 178. 3.

effect

effect is produced by waters charged by the means of the vitriolic acid, with ſimple abſorbent earths, and with fixed alcalies; in thoſe charged with abſorbent earths, and ſome lixivial and muriatic ſalts, ſtringy clouds or filaments of a pale yellowiſh hue; in waters containing a pure volatile alcali, an aſh-colored ſediment; in waters charged with fixed alcalies, a muddy yellow; in waters charged with pure ſea ſalt, a beautiful white precipitate, or rather a kind of cryſtalliſation; for, the acid of ſea ſalt, uniting with that of nitre, conſtitutes that compound mineral acid, called aqua regia, the royal water or ſolvent, from its being the onely proper ſolvent of gold, the chemiſt's King and the Idol of moſt men of what ſect or religion ſoever; this liquor is incapable of diſſolving the mercury; whence, the before diſſolved particles attracting, and being attracted by, the muriatic acid, form thoſe little cryſtals, which are ſtill ſoluble in water, conſequently no true magiſtery or precipitate. But, to the forming of this kind of precipitate, as it is called, the alcaline baſe of the ſea ſalt may contribute ſomewhat, which better deſerves the name. This ſolution of quickſilver gives a pale lemon-colored precipitate with a ſolution of Glauber's ſalt, and with that of tartar vitriolate, a turpeth mineral-colored precipitate. The knowledge of which facilitates our acquiring a juſt notion of the mixture in the water. To aſcertain which, the precipitate is to be examined apart, and the liquor, whence the ſolid matter was precipitated, is to be proved by evaporation, cryſtalliſation, &c. in order to determine what concrete it affords with the union of the acid of nitre.

§ 224. 17. Corroſive ſublimate mercury is recommended and uſed by many in the trials of waters; though, to the beſt of mine obſervation, to very little purpoſe, at leſt, to much leſs than the preceding ſolution. Sublimate is a ſolution of mercury in the concentrated acid of ſea ſalt, in which it is not ſoluble by the ordinary rules of ſolution. But, quickſilver being diſſolved in any other mineral acid, evaporated to a dryneſs, mixed with a certain proportion of ſea ſalt,

ſalt, with or without calcined vitriol, or the precipitate of mercury with ſea ſalt, or its acid dried, and committed to a ſand furnace, in a convenient glaſs veſſel, upon adminiſtring the juſt degrees of heat, the acid of ſalt is ſet in motion, and by a more powerful attraction, wreſts the mercury from the acid, which held it diſſolved before, and by a quality peculiar to the acid of ſea ſalt, that of volatiliſing all metals and metallics, with which it unites, it renders the quickſilver, which is almoſt fixed by any of the other mineral acids, ſemivolatile and elevates it into a fair cryſtalline form, which may be looked upon as a kind of vitriol of mercury. This, though difficultly, diſſolves in pure water, and makes no change in it. This mixed with a burning ſpirit, is uſed internally and externally by our quacks, as Antivenereal Eſſences and Lotions. The mercury is thence precipitated in its proper form, by ſilver, by copper or braſs, and before ſolution, by regulus of antimony, and by tin. It gives a milkyneſs to water charged with ſulphur or phlogiſton. It is precipitated in form of a magiſtery by abſorbents and alcalies: The earths and the volatile alcalies give a white, and the fixed, an orange-colored precipitate. To demonſtrate the later, is its chief uſe in the trial of waters.

§ 225. 18. Lead diſſolves in every vegetable acid, but more readily when firſt corroded by the means of the vapor of a fermented acid as vinegar, whereby white lead is prepared; or when it is reduced to a calx by fire, ſuch as litharge or red lead; by which treatment the metal is in a great meaſure deprived of its phlogiſton. In this ſtate, lead is moſt ſoluble. It then diſſolves readily in all expreſſed oils, in moſt acids, in moſt fermented liquors, the aceſcent eſpecially, and partly in common water; to all which it imparts a ſaccharine ſweetneſs. The preparation, called ſugar of lead, is made by diſſolving any of theſe calces of lead in diſtilled vinegar, evaporating and cryſtalliſing it. And here, I can not omit enveighing againſt theſe fraudulent dealers in wine, who uſe theſe preparations

rations of lead to ſweeten their pricked or ſour wines; than which, nothing can produce more deadly effects. I am likewiſe prompted to inculcate a caution againſt boiling or keeping acid or fermented liquors of any kind in leaden or peuter veſſels, or baking tarts or pyes of green or ſour fruit in diſhes of theſe metals; from which cholics, cramps, convulſions, palſies, and a painful lingering death is frequently brought on. In France, the uſing lead to ſweeten their wines is puniſhed with death. Though all this muſt be confeſſed foregne to my preſent purpoſe, it can not be diſagreeable to the reader to learn a method of diſcovering, whether lead be diſſolved in wine or in any other fermented liquor. This may be done by dropping a ſolution of Hepar Sulphuris into it, which will occaſion a reddiſh brown precipitate, or what is ſtill more certain, a ſolution of orpiment with quick-lime in boiling water, or HOFFMAN's volatile tincture of ſulphur, which will cauſe a black precipitate. By conſidering the variety of bodies, that have a ſtronger attraction or affinity than lead has to this acid or that of nitre in which it diſſolves *, and the acids, as well as abſorbents and alcalies, that cauſe a precipitation of theſe ſolutions †, the uſe of a ſolution of lead in the examining waters will readily appear. The nature of the precipitate is to be proved as before obſerved ‖.

§ 226. 19. The ſolution of ſilver in its proper ſolvent, the nitrous acid, is very uſeful in the trials of waters. This diſſolves, as quickſilver does, and like that, it may be evaporated to a dryneſs or to cryſtals, either of which may be diſſolved in purified water, or the ſolution may be moderately diluted with the ſame, exactly noting the proportions uſed to avoid miſtakes in experiments and compariſons. Upon conſidering the variety of bodies, that have a more powerful attraction to the nitrous acid, than the ſilver has ‡, it is eaſy to ſee the uſe of a ſolution of ſilver

* § 178. 3. 188. & ſeq. † § 204. ‖ § 220. 13. ‡ § 77. 2.

in

in the examination of waters. This ſolution dropped into the pureſt water mixes freely without making any change in it. But, if it contains the leſt veſtige, the ſlighteſt taint of thoſe foregne matters, before * ſpoken to; then, white clouds and a ſpeedy precipitation follows. The cauſe is to be found, by examining the precipitate, and the contents of the liquor, whence it was precipitated †, apart, upon the principles before layed down ‡.

§ 227. 20. Upon the ſame principles, other metallic ſolutions are uſed in the examination of waters; ſuch as thoſe of copper and iron, either in the nitrous acid, or in that of vitriol; ſuch as the ſolutions of the green and blew vitriols afford. But of each a word apart;

§ 228. 21. Copper is of all metals the moſt ſoluble. All ſalts diſſolve it, more or leſs; whence, it is not onely, in ſome meaſure and manner, ſoluble in all acids, but in all alcalies, and even in neuter ſalts, as well as in oils and ſoaps. To the different ſolvents, it imparts different colors, ſuch as different ſhades of blew and green. But, if extremely diluted, it appears colorleſs. Copper corroded by vegetable acids is of a color between a pale green and a pale blew, called verdigriſe. But, diſſolved gives a deep green tincture and cryſtals. Copper diſſolved in the vitriolic acid gives a pale ſaphir-color, in the acid of nitre, if pure, a paler blew; but if tainted with ſalt, as in aqua regia, a berill green; The ſolution, in the acid of nitre diſtilled, comes over colored green with the copper, which ſhews its volatility; diſſolved in the acid of ſalt it gives a beautiful, bright emerald color. Upon conſidering the different attractions of bodies ‖, it is eaſy to conceive how copper is precipitated from all theſe ſolutions, or its color changed in ſolution by different ſolvents. Whatever more ſtrongly attracts the acid, than the copper and the acid attract each

* § 177. 2. &c. † § 176. 1. 181, 182, 183. ‡ § 196. 224. 12. ‖ § 175 to 176.

other,

other, will ſaturate the ſolvent, as faſt as that is effected, the copper is precipitated or rather ſuſpended between the two ſolvents; but, as ſoon as the ſaturation is completed, and the acid ſolvent is by an alcali rendered neuter, then the copper is moſtly rediſſolved by the neuter ſalt; and then, if the alcali be made to predominate, it is again diſſolved in that ſalt. So that copper once ſet in ſolution, it is hardly to be totally precipitated by any means, but iron. The changes of color, it undergoes in ſhifting of ſolvents deſerve attention. The acid of ſalt added to the blew ſolutions of copper, in the nitrous or vitriolic acids, changes them to a fair graſs green. If to any of theſe ſolutions an abſorbent earth be added, a partial precipitation will be performed; If a fixed alcali, a partial precipitation will immediately enſue; but, upon ſaturation or overcharging the ſolvent with the alcali, another ſolution will enſue, but not ſo complete as the firſt; and the color becomes of an higher tinge of blew. This ſuccedes better with the volatile alcalies: Theſe, in each of the ſolutions, cauſe at firſt a partial precipitation; but, as the alcali becomes predominant, a new ſolution is inſtantly brought about; which, in the firſt and ſecond ſolutions, puts on a beautiful ſaphir-color; in the third, that of an amethyſt, all deeper or paler, as the liquor is more or leſs charged with copper. All theſe colors are again deſtroyed by acids; which, at firſt dropping in, cauſe ſome precipitation; but, as they approach to ſaturation, a rediſſolution in the neuter ſolvent enſues, and and a ſtill completer, upon the acid's becoming predominant. The moſt complete precipitant of copper known, is iron: For, this ſo ſaturates the acid ſolvent, as to leave it quite void of copper *. By theſe means, we diſcover whether a water contains copper or not. Or by the adding a ſolution of copper to any water; we may learn what cauſes the precipitation, if any enſues. All the ſolutions of copper have a moſt nauſeous, bitter, offenſive taſte, with auſterity in the acids and acrimony

* § 193, 198.

ny in the alcalies. In very ſmall quantities, it gives extreme ſickneſs and violent vomitings; but, in greater, it approaches very near the deleterious qualities of modern arſenic, that intractable poiſon. This, with its extraordinary ſolubility, even in the air, ſhould caution againſt the promiſcuous uſe of copper veſſels and other culinary utenſils.

§ 229. 22. Iron may alſo be uſed in the trial of waters, upon the ſame principle, with other metals. And to different ſolutions of it, we owe all our martial or ferrugineous waters, commonly called Chalybeate or Steel waters, with impropriety; as ſteel is not known in nature. Iron, though the hardeſt, is yet, next to copper, the moſt ſoluble of the metals. The acid of the air corrodes it, and few waters are known, that are not ſo replete with this acid, as to diſſolve iron. All the mineral acids, in a diluted or concentrated ſtate, attack it with great violence, heat and vapor, and diſſolve it; but, more effectually, diluted. The moſt potent and probably the proper ſolvent of iron, is the vitriolic acid. This, ſeemingly contrary to our general rule *, quits, in ſome meaſure, its favorite phlogiſton to unite with iron: For, if filings of iron and ſulphur, in flowers or powder, be mixed together and moiſtened with water, the acid of the ſulphur and the iron attract each other ſo powerfully, as by their attrition to produce an heat, ſufficient to give fire to, and totally conſume, the adherent phlogiſton; leaving the iron and the acid united; ſo as to form vitriol of iron by elixiviation or infuſion in water, evaporation and cryſtalliſation. This is a kind of artificial pyrite. Some uſe this experiment to ſhew how hot baths and ſulphureous waters are produced. But, unfortunately for theſe ſuperficial ſmatterers in phyſic and chemiſtry, ſuch a compoſition is not to be ſought in nature; becauſe, iron, in a malleable or ductile ſtate, has moſt rarely, if ever, been found in its native place. Beſides, though it had, a ſulphureous water could not be the reſult of waters paſ-

* § 180, 195. 196.

ſing through ſuch a mixture; becauſe, the ſulphur is decompoſed and one of its conſtituent parts burned and diſſipated in the operation. Iron then diſſolves freely in the vitriolic acid; if not very plentifully diluted, much of the phlogiſton of the metal flies off in a combuſtible vapor. When the ſolution is finiſhed, a black cruſt remanes, which, with moſt, has hitherto paſſed for an inſoluble earth; whereas, it is in fact ſulphur, generated by the union of the inflammable principle of the iron and the univerſal or vitriolic acid. The ſolution of iron in this acid, duly diluted, is of a pale graſs green; and evaporated and cryſtaliſed, gives pale green cryſtals, green copperoſe; or as ſome affect to call it, ſalt or vitriol of Mars or iron. This metal diſſolves in the acid of nitre and gives a dark orange colored tincture; it diſſolves in the acid of ſalt, and gives a greeniſh yellow, which ſome abſurdly impute to copper, not conſidering, that copper can not ſubſiſt in a ſolution charged with iron: It diſſolves in aqua regia and gives a yellow tincture; it diſſolves by means of tartar and gives a dark red or brown tincture; it diſſolves in diſtilled vinegar and gives ſweetiſh cryſtals; it is diſſolved by the juices of all acid or auſtere fruits or other vegetable ſubſtances, as is diſcovered by the taſte a knife gives the fruit in cutting, and the ruſt or black color on the blade, which enſues the cutting. It is not difficult to conceive how water ſhould become impregnated with this moſt common, as well as moſt excellent of all metals, when it appears ſo remarkably ſoluble. Upon conſidering the various ſubſtances, that hold a ſtronger attraction with all or any of theſe acids, than iron does *, we ſhall ſee how the addition of any of theſe to a water, impregnated with iron, will diſcover and precipitate that metal; and on the other hand, how a ſolution of this metal dropped into any water, charged with any of theſe matters, will be precipitated, and ſhew the cauſe of the preci-

* § 176. 1. 178. 3. 133. 190, 191, 192, &c. 214. 7. &c.

pitation.

pitation. Thus, for example, powder or infuſion of galls, or the like aſtringent vegetable ſubſtance, thrown into a water, by any of theſe acids impregnated with iron, will cauſe a blew or black precipitation or color; abſorbent earths, volatile or fixed alcalies, will occaſion ochrous precipitations of martial earths; or a ſolution of iron, dropped into water charged with aſtringent vegetable earths, abſorbent mineral earths, or volatile or fixed alcalies, will produce the like effects, for the like cauſes.

§ 230. But, here we muſt not omit an exception to this general rule, which will greatly facilitate our accounting for a principle or ingredient, frequently found in the moſt active chalybeate waters; as in thoſe of Pyrmont, Spa, Malmendy, Bru, &c. as ſhall be ſhewn in the proper place. It has in general been obſerved, and in the laſt article in particular, been inſiſted on, that fixed alcalies precipitate ſolutions of iron. In the general acceptation, there is nothing more certain than this; yet, an exception to it has been diſcovered by a late illuſtrious ornament * to phyſic and chemiſtry, who firſt obſerved, that if a ſtrong ſolution of any pure fixed alcali be gradually dropped into a ſolution of iron in the acid of nitre, keeping it conſtantly, quickly, and thoroughly agitated; ſo far from cauſing a precipitation, it will be found, that a perfect ſolution of this metal in a fixed alcali will enſue: For, the more of the alcaline ley is added after ſaturation, the more complete the ſolution. This ſolution no longer actually contains an acid: For, that, in which the iron was firſt diſſolved is ſaturated with the alcali in the conflict upon mixture; whence, a neuter ſalt, to wit, nitre is produced. This then, is a ſolution of iron in an alcali, which may be proved by theſe conſiderations; firſt, if the ſolutions be both concentrated or very ſtrong, part of the nitre will cryſtalliſe in its natural form, upon lying quiet in a cold place, leaving

* STAHL, opuſ. phyſico chemico-medica.

the iron diſſolved in the remaning ley; ſecondly, either the ſolution, or this remaning ley, now ſuffer a precipitation upon the addition of the weaker acids. This experiment ſuccedes beſt with a ſolution of iron in the nitrous acid. It is deemed owing to the great quantity of phlogiſton in the iron and in the acid of nitre, which ſtrongly attracts fixed alcalies, and forms with them a ſolvent, not unlike that produced upon mixing common ſulphur and a fixed alcali by fuſion: This gives the concrete, called hepar ſulphuris, which becomes a ſolvent for all the metals, gold not excepted: For, metals fuſed with hepar ſulphuris become with the maſs ſoluble in water; whence, both are precipitated by acids.

§ 231. Having thus ſhewn the means of diſcovering the kind and manner of the principal impregnations of waters with variety of matters, in the way of mixture; let us purſue the analyſis by other methods; for, all the known ways of exploring the compoſitions of water, are frequently to be called to our aid, before a thoroughly inquiſitive, rational mind can acquire full ſatisfaction.

§ 232. The ſolid contents of a water may not onely be obtained by the ways of precipitation, before * ſet forth, but alſo by evaporation; in which the connection of the aqueous and terrene parts is diverſly broken and the parts ſeparated. It has before been obſerved †, that moſt of the waters, which contain any ſolid parts, that have hitherto fallen under the cogniſance of the curious, are impregnated by means of an acid of different degrees of ſubtility and volatility; and for the moſt part, by one, as volatile, as the univerſal acid, with which the atmoſphere is charged: Hence, we find the hardeſt waters decompoſed by boiling, which cauſes the depoſing or precipitating the terrene parts, in proportion, as the acid ſolvent eſcapes. The ſame thing happens more ſlowly, when theſe waters ſtand

* § 173, 174, 175, and following. † § 171.

expoſed

expoſed for a few days to the air. This is well known to gardeners and other ruſtics, who let their hard water ſtand to ſoften, as they call it; that is, to let the acid ſolvent eſcape and the earth fall to the bottom. All waters, charged with whatſoever earthy or metallic parts they may be, ſuffer a decompoſition by theſe means. This is extremely evident in the moſt active chalybeate waters, as thoſe of Pyrmont, Spa, Malmendy, and the like, and even in thoſe of Tunbridge; all which, upon ſtanding in the open air a while, in glaſſes, cover their ſides with innumerable air bubbles; which, as faſt as they are ſeparated or eſcape, leave the water turbid, and when they are all diſperſed, let its ſolid contents, which by this means were diſſolved, fall to the bottom; the water, without this ſolvent, being incapable of diſſolving any metallic or terrene matter.

§ 233. As this volatile ſolvent, as well as the water may be exhaled from the ſolid contents; the firſt rational proceſs for the examination of waters, in this way, is by diſtillation. Let then any water, to be tried, be diſtilled, by the apparatus * for purifying water. And let the firſt runnings of it be examined by the means before directed for proving, whether it contains any and what volatile principle, beſides water. The diſtillation may be protracted, till all the fluid be drawn off, trying it from time to time from firſt to laſt, with blew paper, ſirup of violets, with acids, with alcalies, with ſolution of lead and ſilver. If theſe make no ſenſible change in it, we may preſume the diſtilled water pure, as art can make it, and that the acid has been either altered by the fire, or by its extreme ſubtility made its eſcape in the operation. I have obſerved ſome waters, which diſtilled, gave no ſenſible proof of acidity; yet, a piece of blew paper, layed in the juncture of the diſtilling veſſel, has been found in divers parts ſtained red; a full proof at once of the exiſtence and ſubtility of this acid.

* § 92 to 98.

§ 234. The ſediment, that remanes in the glaſs, is the ſolid and fixed contents of the water. But, this is not the moſt exact method of collecting it: For, the heat requiſite for diſtillation, is more than neceſſary and prejudicial in evaporation; which can hardly be done too ſlowly. Becauſe, we know by experience, that too great heat in the evaporating moſt ſalts for cryſtalliſation, ſenſibly alters them in quantity and quality. Therefore, to obtain the ſolid contents of any water, let it be ſet in a flat or low glaſs veſſel, placed over the gentle heat of the vapor of heated or boiling water, in boiling or heated water, or in an heat analogous, in a ſand furnace. Let it be layed, where no duſt or foregne exhalations can foul or otherwiſe alter it, and then let it be ſlowly evaporated to a dryneſs.

§ 235. As all, that is volatile, and that onely, eſcapes in this proceſs; the ſolid contents are thus as fairly obtained, as poſſibly may be, by art. In this ſediment, we have all the fixed, ſolid parts, that are by art ſeparable from the water; as in the diſtillation or evaporation, all that is truly volatile flies off. However, we muſt be cautious of pronouncing the proportion of ſolid contents in a given quantity of any water from what it is found to yield upon one or two trials in the way of diſtillation or evaporation: For, great variety will be occaſioned by the different degrees of heat, and the make of the veſſels, uſed in the operation. Becauſe, it is found by experiment, for which it is not eaſy to account rationally, that water, boiled in open veſſels, leaves much leſs terrene ſediment, than when it is boiled in cloſe or covered veſſels; which poſſibly may be owing to this, that the union of ſome matters, by means of this ſubtil acid diſſolved in the water, is ſuch, that, as in the tartar vitriolate, it may eſcape in the boiling; but, being reſtrained in cloſe veſſels, the ſubtil ſpirit may be firſt diſſipated and leave the ſalt or earth to ſubſide.

§ 236. The waters, that are left charged with ſolid mineral matters, muſt be the lighteſt, are ſooneſt heated, and ſooneſt cool, readieſt diſtil, and leave the ſmalleſt quantity of ſediment in evaporation. Such are the waters of Slangenbadt, of Taeplitz and Pfeffer, beforementioned, and that of Zeffen or Seffen, a moſt curious, pure, cold ſpring near Aix la chapelle, whoſe water very nearly equals that of Pfeffer in lightneſs and purity. The exception to this rule, which ſome offer from Lime-water, which appears highly charged by various experiments, yet is ſayed to leave little or nothing behind it in evaporation, is now of no force; as by more accurate experiments, it appears to be a groſs error. *

§ 237. There are few or no waters, whether meteoric or terreſtrial, known, that do not leave a conſiderable quantity of an heterogeneous maſs behind them in evaporation. To which point, we have the concurrent teſtimony of ſome of the moſt learned, induſtrious and obſervant profeſſors of chemiſtry.

§ 238. BORRICHIUS † took of limpid ſpring water, as well as that of rain, ſnow, hail and froſt, one hundred pounds and evaporated them apart, in clean glaſs veſſels, to one pint each. In this, ſome terrene feculency ſhewed itſelf, which being ſeparated by filtrating it through ſoft, porous paper, the ſtrained liquor appeared of a red color. This liquor, he committed to a clean glaſs cucurbit, ſet it in a bath-heat, and, by ſlow evaporation, reduced it to the conſiſtence and color of gely of corinths. This extract, being continued in the bath-heat, was at length reduced to a dry powder, which melted with bubbles, and overrunning its bounds, took fire and burned with a clear, bright flame, which gave proof of an oily ſubſtance. The remaning burned maſs, being waſhed with diſtilled water, yielded a ſaline ley, which gave fair, cubical cryſtals of ſea-ſalt, by evaporation, and left an

* § 57. 4.
† De Herm. et Ægypt. Sapientia.

inſipid earth behind. The extract diluted with diſtilled water gave a red tincture not ungrateful to the palate; which, being filtrated and expoſed during the ſummer months in a wide-mouthed glaſs, as the water gradually exhaled, coaleſced into ſplendid, brilliant, cubical cryſtals, in themſelves colorleſs, but interlayed with the oily coloring matter, which was inflammable. The proportion of this ſalt to the oily ſubſtance is never certain: ſometimes it is found as three to one, at others, as ten to one. The thick extract diſtilled by a retort yields firſt a ſmall portion of an oily, inflammable ſubſtance, and afterwards, ſome acid ſpirit.

§ 239. Though KUNKEL's * experiments do not exactly agree with this; yet, do they not eſſentially differ the one from the other. This moſt aſſiduous and accurate chemiſt tells us, that after evaporation of a moſt immenſe quantity of rain water, a blackiſh, ſaline earth remaned; which being much expoſed to the air and then diſtilled by a retort, yielded an acid ſpirit and an empyreumatic oil; or being ſet on fire, after the inflammable parts were conſumed, an aſh-colored, alcaline powder remaned.

§ 240. The ſeeming difference of theſe two proceſſes ſerves onely to ſhew, that rain water is very different, in certain ſeaſons and places, from what it is found in others. Indeed, it is not to be expected always of the ſame nature in any one place, however carefully it be collected; as its variation depends upon that of the atmoſphere. It is always found to contain more or leſs earth and ſalt and ſome oily matter; but, it is often charged with various other mineral matters. Some writers, extremely ſollicitous to prove a long prevaling erroneous or artful aſſertion, of certain waters containing ſulphur, think they have ſucceded in obtaining this oleo-ſaline extract † from their waters.

* Obſerv. chemic.

† § 238, 239.

But, ſurely this proves more, than they wiſh; ſince, by this rule, they muſt find themſelves hard ſet to point out a water void of ſulphur, if they deem this oily ſubſtance ſuch, from which there is hardly any water quite free.

§ 241. But, neither of theſe experiments * has the neceſſary accuracy for a perfect analyſis of water; the proportions are to be determined with the ſtricteſt exactneſs. The quantity of water uſed is to be firſt aſcertained, and the reſiduum, when carefully and cautiouſly dried, weighed with a true balance. Then, the conſtituent parts of this remaning maſs are to be enquired into and eſtabliſhed upon certain, not hypothetical, principles, and by teſts more concluſive, than the ſenſes alone can afford.

§ 242. Theſe maſſes are generally found, as well in the terreſtrial, as atmoſpheric waters, to conſiſt of different kinds of ſalts, 1. alcaline, 2. neuter, which are of different kinds, 3. earth, which is commonly of three kinds, and 4. with more or leſs of the oily ſubſtance.

§ 243. It has been obſerved before †, that ſeveral ſalts may be blended together in the ſame water. If ſo, we may look for the reſiduum after the evaporation of waters to be in general very compound; and the preceding tables ‡ furniſh hints how the different parts may be ſeparated.

§ 244. But, it rarely happens, that we find more than three different ſalts together, that can be ſeparated in a dry or concrete form, in any one water. And theſe, for the preſent laying the ſelenite aſide, are, 1. the mineral alcali, the nitre of the antients; 2. ſalt gem, or ſea ſalt; and 3. a compound of the firſt or of the baſe of the ſecond with the vitriolic acid, a ſalt bearing great analogy to that of Glauber, falſely by ſome taken for nitre, LISTER's nitrum calcarium. Theſe, our tables ‖ teach us to ſeparate readily:

* § 238, 239. † § 121. ‡ § 118, 119, 120.
‖ § 118 to 122.

For,

For, they ſhew us, that upon throwing water on the maſs, the alcaline ſalt will firſt diſſolve, next the ſalt of the nature of Glauber's or Epſom ſalt, and laſtly, the ſea ſalt or ſal gem. But, this wants due accuracy: The beſt method is to waſh the whole maſs carefully with warm, diſtilled water, while to the taſte, or upon experiments, with ſolution of lead, ſilver, or the like, it ſhews the leſt veſtige of any ſalt. The remaneder is a matter inſoluble in water; to wit, earth; which, being carefully and effectually dried, is to be exactly weighed; and its weight being ſubſtracted from that of the whole mixed maſs, the difference tells us the quantity of groſs ſaline matter in the maſs. Then, this maſs of ſalts may be parted, as the tables * direct: The ſea ſalt will firſt cryſtalliſe; next, the Glauber's ſalt, leaving the unſaturated alcali to be evaporated to a dryneſs. Theſe ſeverally dried, their quantities or proportions are to be determined by the balance.

§ 245. Having parted the ſalts, we are next to examine and determine their kinds. The alcaline ſalt is proved, 1. by an acrid, lixivial or urinous taſte; 2. by changing blew ſirups, green, 3. by an ebullition with, and ſaturation of, all acids; conſtituting a neuter ſalt, according to the nature of the acid employed †; 4. by precipitating metallic and terrene ſolutions, made by the means of acids; 5. by precipitating a ſolution of corroſive ſublimate in an orange-colored magiſtery; 6. by inlarging or diſmiſſing the volatile alcali in ſalt ammoniac and taking its place. The marine ſalt is diſcovered, 1. by its well known taſte, not equalled by any other; 2. by the pyramido-cubical form of its cryſtals; 3. by its decrepitating, cracking and burſting into very ſmall fragments upon being thrown on burning coals or an ignited iron; each molecule betraying, by its form, from what ſtock it ſprung; 4. by pouring the ſtrong acid, called oil of vitriol upon it, whereby a violent commotion and heat is excited from

* § 210, 121. † § 176. 1. 181.

the

the ſtronger attraction between the vitriolic acid and the baſe of the ſea ſalt, the mineral alcali, than between this and its own acid; whence, the acid of ſea ſalt, being the moſt light and volatile, flies off in white fumes; 5. by its making a ſolvent for gold, aqua regia, with aqua fortis; 6. by precipitating mercury, lead and ſilver diſſolved in the acid of nitre and volatiliſing each in mercury ſublimate, ſaturnum cornuum and luna cornua. The nature of the other neuter ſalt is diſcovered, 1. by the ſize and figure of its cryſtals; 2. by its fuſibility; Glauber's and Epſom ſalt flowing with a gentle heat, vitriolate tartar, reſiſting the moſt violent; 3. Theſe kinds of ſalt are diſtinguiſhed from nitre, to which they bear the greateſt reſemblance in form, by loſing their pelucidity and crumbling into a white powder in drying; by fuſing and drying, not fulgurating or flagrating, upon being thrown on a red hot iron or coal; by mixing, without any commotion, with the ſtrongeſt acids; whereas the ſtrong acid of vitriol propels the acid of nitre in red fumes, with a violent commotion and heat; by all, but the tartar vitriolate, precipitating a white abſorbent or alcaline earth, when diſſolved in water, upon the addition of a vegetable fixed alcali to the ſolution. Moreover, 4. all theſe ſalts by fuſion with one part charcoal powder, with or without the addition of a fixed vegetable alcali, which the tartar vitriolate requires to promote its fuſion, being fluxed, yield a maſs analogous to hepar ſulphuris, which, like that diſſolves in water, and yields ſulphur in form of a magiſtery upon the addition of any acid *. Of this kind are all the neuter ſalts, hitherto diſcovered in all the waters of Europe. How different from nitre or ſalt petre, let any one conſider, who knows the remarkable effects, which attend the committing nitre, charcoal and ſalt of tartar to the fire, when they want but one of the ingredients of gun-powder, or of that compound, called pulvis fulminans, from the violence of its exploſion.

* § 196, 197, 198, 199, 200.

§ 246.

§ 246. The proportion and quality of our ſalts being thus determined, procede we next to the examination of the inſoluble, ſolid, fixed contents of our water, the terrene parts. Upon conſidering the variety of earthy particles floating in the atmoſphere, the various earths, of which our globe and its furniture are compoſed, and the great and almoſt boundleſs extent of the diſſolving faculty of water; we may be ſtaggered at the bare attempt. But, however great, and, to the ſenſes, ſeemingly endleſs, the diverſity of earths, from different modifications, may appear; yet, the real diverſity is certainly not ſo great; for, all terrene bodies, of what kingdom or claſs ſoever they be, have but one common baſe, earth, truly and properly ſo called; the ſalt, or the ſalt principle of the ancients, Terra Prima, the primary or vitrifiable earth of the modern chemiſts, in diſtinction from their Terra Secunda, the phlogiſton or inflammable principle, and from their Terra Tertia or mercurialis, the third or mercurial earth, or metalliſing principle; which, with water, are the principles or elementary particles, of which all material beings are compoſed, and conſtituted, as the chemical philoſophers * demonſtrate. However, we are not to look for mere elementary earth in our waters; but for an aggregate of groſs terrene parts; and thoſe, that have hitherto been diſcovered, fall under the general denominations of calcarious, argillaceous, or ochrous. The terrene reſiduum of water is known to be calcarious or abſorbent, 1. by its diſſolving in acids, with an ebullition; 2. by its becoming upon calcination, more white, and acrid to the taſte, inſtead of inſipid; then, by hiſſing in, and heating, water, and partly diſſolving, upon immerſion therein; in ſhort, by its putting on the character and qualities of lime. Waters, conſiderably charged with this earth, by the vitriolic acid, are of a petrifying nature. This quality is moſt evident if they be natural baths; there, we find the ſources, canals and receptacles full of

* BECHER, STAHL.

ſtoney

ſtoney concretions, as in the Caroline Baths, in thoſe of Aix la Chapelle, Borſcheit, &c. The ſediment or reſiduum of waters is known to be argillaceous, 1. when it cauſes none ebullition, and diſſolves not with acids; 2. when, inſtead of becoming whiter and more pulverulent by calcination, it puts on a darker color, and a ſtoney hardneſs. The ochrous or martial earth is diſtinguiſhed, 1. by its yellowiſh, rediſh, or brown color; 2. by its tardily diſſolving, without much commotion, in acids; 3. by its growing red by calcination, and partly anſwering the attraction of the load-ſtone; 4. by yielding fuſible iron, upon cementation or calcination, in a cloſe covered crucible, with oil or fat, particularly lin-ſeed oil.

§ 247. But, theſe are not the onely terrene bodies, we find diſſolved in water: we ſhall, in the ſequel, find another ſubſtance intimately ſuſpended in water, which, as ſoon as it puts on a concrete, though it be a ſaline form, is then nevertheleſs as inſoluble, as any earth or ſtone: I mean the ſelenite, which, upon a ſlight evaporation, immediately after the ochrous or martial earth, precipitates in pellucid fleaks, in the Pyrmont, Spa, and ſome other waters.

§ 248. Having thus layed down general rules for the examination of all waters, ſhewn how they may be impregnated, and how that impregnation may be diſcovered, I now come, according to the order propoſed,* to conſider the ſimple, ſweet, or inſipid terreſtial waters, beginning with the principal waters uſed in the oeconomy of life in and about our capital, which at preſent demands my chief attention and care.

Of the common waters, in general uſe, in and about London.

§ 249. After a man has in the proper ſcholes acquired that pitch of erudition and knowledge of na-

* § 25. II. 1.

ture,

ture, which intitules him legally to the appellation of Phyſician, and really qualifies him to judge of matters in general, of man, and ſuch things as relate to his health in particular; his firſt care ſhould be to inform himſelf, as well as poſſible, of the nature and qualities of the climate, in which he purpoſes to practice, to make himſelf well acquainted with the ſoil, the air, and the water, together with their ſeveral products, whether conducive to, or deſtructive of, the life or health of mankind: Without this, no man can be preſumed capable of directing the uſe of the proper air and aliments, the avoiding noxious things, and much leſs for pointing out other means for ſupporting life, preſerving preſent, or reſtoring interrupted or loſſed health. And therefore, the phyſician, that wants this branch of natural knowledge, muſt be very defective in his profeſſion.

§ 250. Of all theſe matters, none ſeems to have leſs engaged the attention of the judicious, than the examination of waters in general; ſuch eſpecially, as are uſed for the ordinary purpoſes of life. Some regard, it is true, has been payed to the mineral waters; they have employed the pens of many. But, what degree of eſtimation authors deſerve, who take upon them to treat of compound bodies, without explaning or examining the ſimples of which they are compoſed; who pretend to analyſe a compound mineral water, without giving, or perhaps, forming to themſelves, any idea of a ſimple water, let men of common ſenſe determine. To which, by the bye, let me add, that moſt of the voluminous and numerous tracts, and of theſe the moſt pompous, we have, upon mineral waters, have been publiſhed by men living or practiſing upon the ſpot, not always competent judges of the ſubject, but always intereſted in the fame of the particular water, which was their idol, the Diana of the Epheſians; and always intereſted in letting the world know, by a book or pamphlet, calculated for the purpoſe, where the mouth of the oracle,

ele, the Prieſt of the myſteries was to be conſulted: Such a man's evidence muſt therefore be deemed as doubtful, concerning the efficacy of his favorite water, as that of any other prieſt touching the miracles of the ſhrine, by which he gets his bread.

§ 251. Before I procede to the conſideration of the mineral or medicinal waters, I ſhall firſt examine thoſe, that are immediately neceſſary to life, the ſimple waters. Of theſe, we are ſerved with greater variety and abundance, than any city in Europe can boaſt: There is not a conſiderable ſtreet in London which is not furniſhed with ſuch plenty of water, by way of aqueducts or pipes, from various ſources, beſides what its wells by pumps ſupply, that not onely the ordinary offices on the ground floor, or under it, in every houſe, but even the upper ſtory of moſt houſes are, or may be, ſupplied with water by pipes from the common aqueducts in the ſtreet. Such is the plenty of this uſeful element, that in many of the great ſtreets there is enough to ſerve the common draught cattle, and proper repoſitories are fixed to receive and keep it for theſe purpoſes. Beſides, in moſt of the broadeſt ſtreets, there are common cocks for watering the ſtreets in ſummer; from the overflowings of which, moſt places are ſupplied with water enough to ſuppreſs duſt and cool the pavements in the ſummer, and to waſh away their filth in a running ſtream through their cannals in the winter. This plenty of water prevents our having a number of hands, which may be better employed, occupied in hawking water about, as may be ſeen in Paris, and other great cities; and undoubtedly is one of the principal cauſes why our capital is the moſt healthful great city in the world.

§ 252. The ſources, whence we draw our ſupplies of water, are various, excluſive of our wells, which are very numerous and conſiderable. The firſt and great ſource is the river Thames, that great ornament and ſupport of our kingdom in general, but particularly of our metropolis. From this, water is drawn by machines,

chines in different places, as at London-Bridge, Chelſea, and at York-buildings, and conveyed by proper aqueducts to different parts of the town. The ſecond is that, called the New-River, brought in an open water-courſe from the river Lee in Hertfordſhire, to Iſlington; whence, it is conveyed by pipes to furniſh a great number of ſtreets in town. The third, is Hampſtead, where rain water, together with that of ſome ſprings, is collected and dammed up in ponds, and thence conveyed by pipes to town. The fourth, is a large ſpring, at the end of Rathbone-place, whoſe water is raiſed by a machine, now wrought by an horſe, and thrown into an open repoſitory, where it ſtands, till it is ſuffered to run by pipes to the ſeveral ſtreets in which it is uſed.

§ 253. To theſe the different wells, that furniſh the town may be added. But, as it would be endleſs to recite the extreme variety of them, I ſhall confine myſelf, for the preſent, to ſome of the moſt remarkable and moſt generally uſed of thoſe, that have, as yet, fallen under mine obſervation.

Of THAMES WATER, *as it is commonly uſed in London.*

§ 254. For the trials of this water, I judged neceſſary to be made, I had it taken up, at the different times of the tide, over-againſt Somerſet-Houſe, about the middle of the river. Here, I ſhall ſet down the extremes onely of high and low water, and the experiments made upon it at theſe times of the tide, as one of the principal cauſes of the changes wrought in this water. It is alſo fit it ſhould be noted, that I made mine experiments in warm weather in May, when there had been no rain for above three weeks: Rivers, and even ſome ſprings, will be found to vary according to the quantity, as well as the quality, of the rain they receive.

§ 255. The water at low, as well as high water, was turbid, but the later moſt ſo. Upon ſtanding

to

to ſubſide, it grows clear, but not perfectly colorleſs.*

§ 256. Paſſed through filtrating paper, it becomes quite clear; but, ſtill retains ſome pale ſhades of a white wine-color. The coffin of paper, through which it paſſes, being weighed before, and, upon drying, after filtration of a pint of the low water, will be found to increaſe in weight from under half a grain to upwards of a grain and even to one grain and an half; the high water increaſes to two grains and ſometimes upwards. This is the proportion of inſoluble matter, quite foregne to the nature of water, found at different times in the Thames at London; which, for all the nicer purpoſes, ſhould be ſeparated before uſing.

§ 257. In the following experiments, two ounces of the water was uſed in each; the letter L. denotes the low and the letter H. the high water compared;

§ 258. 1. Sirup of violets twenty drops, is firſt diluted onely; but, upon mixture, changes to a ſea green, which heightens ſomewhat upon ſtanding with L.

§ 259. 2. The like appearances are produced in H.

§ 260. 3. Infuſion of Campechy log-wood in diſtilled water, of a very deep yellow, or dark orange color; in L. every drop, as far as four or five, upon mixing is changed to a pink color, which, upon ſtanding, is heightened to a crimſon.

§ 261. 4. In H. a ſimilar effect is produced; but, the color paler, and inclining to a roſe purple.

§ 262. 5. A grain of cochinelle in powder thrown into L. ſtrikes a pink bloom on mixture, which, upon ſtanding, firſt heightens to a crimſon and then fades to a pale muddy purple, letting fall obſcure green clouds.

§ 263. 6. The ſame in H. produces nearly the ſame effects, the purple brighter and the clouds paler.

* Thames water at Richmond is always, in dry weather, perfectly colorleſs and pellucid. Its receding from theſe qualities muſt be owing to the foregne mixtures it receives about London.

§ 264. 7. Alcaline ley, five drops, in L. each shews a slight milky cloud, and upon mixture, it becomes milky all over. Upon standing, the glass becomes slightly coated with a pale earth, whilest an inconsiderable light sediment is found at the bottom.

§ 265. 8. In H. the like appearances in general, seeming somewhat more milky.

§ 266. 9. A solution of soap, in L. caused a kind of pearl-colored milkiness; but, no coagulation; for, next day, the mixture appeared pretty smooth and uniform.

§ 267. 10. In H. the like appearances as in L. at first; but next day, some grumous coagulations were found.

§ 268. 11. The diluted acid of vitriol works no perceptible change in either L. or H. and consequently none other, of inferior strength, works any.

§ 269. 12. A solution of quicksilver in the acid of sea salt, that is, mercury sublimate, dissolved in a sufficient quantity of pure water, this, as far as ten drops, wrought no sensible change on mixture with L. Upon standing, a mother of pearl-colored pellicle covered the surface, leaving the liquor underneath slightly milky.

§ 270. 13. In H. much the same effects were wrought; the pellicle was paler, and some very light grumous precipitate appeared.

§ 271. 14. A solution of mercury in the acid of nitre; This produced pale clouds at every drop, which appeared at first milky and white, but soon changed to a yellowish color. I added four drops; being mixed, the liquor got the same color all over. Upon standing, a slight, pale pellicle arose and a muddy ochre-colored sediment subsided.

§ 272. 15. In H. the like effects were shewn, with a somewhat larger precipitation.

§ 273. 16. A solution of lead in distilled vinegar; of this every drop, as far as four or more, caused a bright milky cloud; which, growing more opac and white,

white, ſubſided. At four, being ſtirred, it had a milky opacity all over. Upon ſtanding, it threw up a broken, pale pellicle, and let fall a ſlight, white precipitate.

§ 274. 17. With the H. the difference of effects were not ſenſible.

§ 275. 18. A ſolution of ſilver in the acid of nitre, to four drops, in L. cauſed a pearl-colored milkineſs firſt in clouds; upon ſtirring, all over. Upon ſtanding, this ſubſided, covering the bottom and ſides of the glaſs with a fair, violet purple precipitate.

§ 276. 19. In H. it produced ſimilar effects, the precipitate inclining more to the roſe, than the violet, yet partaking of the color of each.

§ 277. By what has been ſayed, in the general idea of ſalts and the method of examining waters, it is eaſy to conceive the cauſes of theſe changes, or rather to what mixture in the waters, they are to be imputed. From Exp. 1. 2. an alcaline principle in a ſmall quantity is aparent in Thames water at London; leſs at high, than low, water; beſides, at that time, ſome particles more of ſea ſalt mix with it, than can be in it when the tide is out. 3, 4; 5, 6; ſhew a calcarious earth diſſolved in the marine acid, with perhaps ſomething of the volatile alcali; whence it appears an unfit water for the ſcarlet dye. 7, 8. ſhew both charged with terrene parts, which muſt have been diſſolved by means of an acid; of which the H. ſeems to contain more than the L. by its giving more precipitate with the ſame quantity of alcali. This notion ſeems confirmed by 9, 10. in the former of which, the ſoap unites with the water; whileſt in the later, it is partly decompoſed. 11. ſhews, an alcali is not predominant in either. By 12, 13. it appears, the quantity of alcaline matter is moſt inconſiderable. By 14, 15, that ſome abſorbent earth, by the means of an acid, is ſuſpended in the water; of the later of which more appears in H. than in L. water, by the later

experiment. This acid appears to be the univerſal, from the color of the precipitate; which, were it the acid of ſalt, ſhould be a pure white. This terrene impregnation is ſhewn above, 7, 8; 9, 10. In further proof of theſe, come 16, 17. As 18, 19 do, to demonſtrate ſome portion of a muriatic ſalt, of which there appears moſt in H.

§ 278. To give farther proofs of theſe trials, and to determine the proportions and natures of the ſolid contents in this water, evaporated, after having firſt filtrated it, at different times of the tide. I ſhall here onely recite the extremes: I took a gallon of the Thames at low water from the former place, ſet it in a clean glaſs bell or pan placed in ſand, in a ſand furnace. I gave fire gradually, till a vapor aroſe; and kept it in that degree of heat, raiſing it out of the ſand, as the humidity exhaled, till the whole was conſumed. In the proceſs, I obſerved, 1. as it heated, it threw off ſome air in bubbles to the ſides of the glaſs and ſurface; but not ſo much, as moſt of our ſprings and pumps; 2. It grew ſomewhat milky; 3. It threw up a terrene pellicle; 4. During this time, no remarkable ſmell could be perceived from it; 5. The liquor, which was not at firſt perfectly colorleſs, as the humidity exhaled, the remaning part appeared more colored, even to that of white wine, and ſtill deeper towards the end; 6. As it conſumed, it left ſome light, pale earth along on the ſides of the glaſs, looſely adherent; 7. When it was reduced to about three or four ounces, it began to coat the glaſs round its ſurface with a thick, brown, ſeeming greaſy cruſt; this continued for about half an inch, but, 8. below it, nothing remaned, upon completing the evaporation, but a thin coating of coarſer, ſandlike earth, ſlightly, if at all, adherent. 9. Expoſed to the open air, at the lower part eſpecially, it contracted ſome humidity, and grew ſoft and pultaceous. 10. The glaſs ſet again in warm ſand, it readily dried as before; being carefully gathered and mixed, it appeared of a dark

dark olive or lute color, and weighed fiveteen grains. It felt gritty or ſandy between the teeth, and taſted ſlightly bitteriſh, acrid and ſaline.

§ 279. One gallon of Thames, at high water, exhibited the like appearances and products, upon the ſame treatment; but, a greater quantity of ſolid contents: For, the reſiduum dried with equal care weighed ſixteen grains and an half, which taſted evidently more ſalt, than the preceding.

§ 280. Thus it appears, that every pint of purified Thames water, at London, contains, in the one extreme leſs in the other more, about two grains of ſolid matter, which now remanes to be examined.

§ 281. 1. This matter, with the ſtrong acid of vitriol, cauſed a ſtrong ebullition and ſome degree of efferveſcence; and emitted ſome fumes, with all the ſenſible appearances of the acid of ſea ſalt.

§ 282. 2. In the diluted acid of vitriol, a very ſenſible ſtrong ebullition, which continued long, without a complete ſolution.

§ 283. 3. Ten grains of the dry matter, waſhed with an ounce of pure water, gave it the tincture of mountane wine, and left in the filtrating paper ſix grains of inſoluble, conſequently terrene, matter, of an aſh color.

§ 284. 4. The waſhings of this, 1. grow milky with alcohol: 2. work no very remarkable change in ſirup of violets; 3. are not ſenſibly affected by acids; unleſs the vitriolic, which in large quantities, expels the fumes of the ſalt, with a great efferveſcence, and forms a ſelenite; 4. mix with alcaline leys without anycommotion; but ſuffer a conſiderable precipitation, which is of the nature of magneſia alba; 5. precipitate a ſolution of quickſilver, not perfectly white; 6. that of ſilver, into luna cornua; 7. evaporated, they leave the glaſs coated in pale yellow rings, which, ſcraped off, give about three grains in weight, of a ſaline and oleoſe taſte, which grows moiſt in the air; 8. rectified ſpirit of wine poured on it and digeſted, diſſolved and carried off the coloring matter,

leaving the ſaline behind; 9. Theſe diſſolved in water gave cryſtals and every other proof of ſea ſalt, weighing near two grains; but, could not be kept long dry; 10. The tincture had an higher aromatic ſmell and taſte than the ſpirit; 11. It grew milky upon mixture with acids; but, without any ebullition; 12. It did the ſame with pure water.

§ 285. 5. Ten grains of the firſt reſiduum thrown into a ſmall, well ignited crucible, it fumes and flames, and gives a ſmell, ſuch as if oil or greaſe were burning, without any ſenſible acid vapor or blewneſs in the flame. It then becomes black. Upon urging the fire, till it is ignited all over, it ceaſes to fume; does not fuſe; changes color to a pale aſh color; loſes ſomewhat better than four grains of its weight, and gets ſomething of an alcaline or acrid taſte.

§ 286. 6. The waſhings of this calx, 1. taſte like lime water preciſely, and like that throw up a pellicle on ſtanding; 2. turns firſt to a bright and then to an obſcure green with ſirup of violets; 3. becomes milky and lets fall a fine white precipitate with volatile and fixed alcalies; 4. mixes without commotion with diluted acids; and gives every other known proof of being a perfect lime water.

§ 287. From § 281. 1. and § 282. 2. It appears, that theſe mixed ſolid contents of our water contain, an abſorbent earth and ſea ſalt. § 283. 3. and § 285. 5. ſhew the terrene parts to be ſix grains in ten. § 284. 4. proves the coloring, which is probably an oily, matter, together with the ſaline, diſſolved in the water, to be four grains in ten. § 284. 4. N°. 6. demonſtrates about three of theſe four grains to be ſea ſalt, with a ſuperabundance of its acid and ſome earth, whence it is apt in part to deliqueſce; the reſt an oily matter. And § 285. 5. and § 286. 6. prove the earth to be calcarious. Of the ſaline or ſoluble parts, more in the ſequel.

§ 288. Theſe are the conſtituent parts of Thames water and their proportions at low water, in London.

The

The onely difference obſervable in the high, is a little more ſalt.

§ 289. Many have ſought, and ſome ſpoke of, a ſpirit to be extracted from Thames water. It is found liable to ferment and putrify. This may happen from the oily matter and others in the water; yet, it chiefly happens when it has layen ſometime in wooden veſſels. What it then affords by diſtillation is by no means to be imputed to the water alone; it partly belongs to the extractive parts of the wood, which the water diſſolves, ſubtiliſed by fermentation or putrefaction. But, from the component parts of the water, and from the immenſe variety of mixtures, it receives from the city, it will not be wondered, if it ſhould be more apt than ordinary to ferment and putrify. The products of fermentation and putrefaction are not to be attributed to the water; both of theſe are but creatures of theſe operations, and conſequently, foregne to the water, in the natural ſtate; in which alone it falls under our cogniſance here.

§ 290. This is found one of the lighteſt, pureſt, ſofteſt and beſt river waters, into which the tide flows. The quantity of matters, foregne to pure water, contained in it, is very inconſiderable; notwithſtanding the immenſe quantity it daily appears to receive. It is not eaſy to collect rain water with much leſs; eſpecially near a great city. And though the proportions may be found to vary, yet theſe ſame principles or rather mixtures are to be found in ſome degree in moſt waters, that touch the earth.

§ 291. Such ſuperficial naturaliſts, as enter upon the examination of ſome one or more medicinal waters, without having ever enquired into the nature of ſimple water, or compared the one with the other, are apt to aſcribe the virtues of their favorite water, which, with many, may be conſidered as their idol, to ſome one or more of the ingredients, now demonſtrated in the Thames, and to be found, in ſome degree, in all waters, ſimple as well as medicated. Upon looking into

any of our modern thermal phyſicians, it will readily appear, that they aſcribe ſulphur and bitumen, and even give the epithets, ſulphureous or bituminous, to certain waters, for no better reaſon, than an oily ſubſtance appearing in their reſidua, as here. The ſenſible will aſſuredly beware of confiding in ſuch waters, as ſulphureous; when all he meets, whether hot or cold, are generally ſuch, in ſome meaſure. And who ſhould truſt the phyſician, who relies on any water for ſulphureous qualities, which are found as plenty in ſprings, rivers, lakes and ponds, as in his boaſted Bath?

Of the NEW RIVER WATER.

§ 292. Next in order, as in importance in the oeconomy of life, to this metropolis, is the great ſource of water, with which our city is ſupplied by an aqueduct from Hertford-ſhire; I mean the New River, whoſe water is conveyed from the reſervoirs at Iſlington to many different parts of our capital. This water bears great analogy to that of the Thames at low water, as appears by the following experiments.

§ 293. 1. It is nearly the ſame in pellucidity and color, at the taking up from its courſe, and when fined by ſubſidence or filtration; in the later, it leaves much the ſame quantity of foulneſs.

§ 294. 2. It gives a paler green with ſirup of violets.

§ 295. 3. It gives a paler pink color, with Campechy wood; but, heightens in the ſame manner and degree with Thames at low water.

§ 296. 4. With cochinelle, it produces the like appearances, as that.

§ 247. 5. The ſame effects are alſo produced in both, with fixed alcalies, concrete and liquid; but, in a ſlighter degree; for, this becomes leſs milky and ſhews leſs ſediment.

§ 298. 6. With a ſolution of ſoap, it becomes leſs milky, and upon ſtanding ſhews no coagulation or ſeparation,

§ 299.

§ 299. 7. It ſuffers no ſenſible change with acids.

§ 300. 8. With a ſolution of corroſive ſublimate, it ſuffers no viſible change at mixture; upon ſtanding, it throws up a diverſicolored pellicle, in which orange appeared to predominate. There was no perceptible milkineſs nor other alteration, but many ſmall air bubbles about the glaſs.

§ 301. 9. With the ſolution of mercury, it produced much the ſame appearances, as L. with rather a ſlighter precipitation.

§ 302. 10. With the ſolution of lead, all the ſame appearances, but in a lower degree, were produced.

§ 303. 11. With the ſolution of ſilver, it wrought the like effects; but ſlighter; and with the precipitate of a pale violet color.

§ 304. As this water is found to bear ſuch analogy to that of the Thames at low water, as to point out a compariſon; the reaſon for the effects of theſe trials are to be ſought under the former head.

§ 305. I committed this water to evaporate in the ſame manner, as that of the Thames was before treated. I found it yielded all the ſame appearance, but in a lower degree; except air, which ſeemed in this more abundant. The reſiduum was of a pale color. And a gallon yielded but fourteen grains. This ſeemed alſo leſs ſalt to taſte.

§ 306. 1. This matter in the ſtrong and diluted acid of vitriol gave the ſame appearances and produced the ſame effects as in § 281. 1. § 282. 2.

§ 307. 2. Ten grains of it gave not ſo ſtrong a tincture as in § 283. 3. Left in the filtrating paper, of terrene matter of a paler color than before waſhing, above ſeven grains.

§ 308. 3. The waſhings, 1. deſtroy the color of ſirup of violets, and then give a pale ſea green upon ſtanding; 2. become milky with alcaline ley and with alcohol; 3. are not ſenſibly affected by diluted acids; 4. cauſe a milkineſs and precipitation with a ſolution of quick-

ſilver,

ſilver, leſs colored than that in § 284. 4. 3. and the like precipitatation of luna cornua, in a ſolution of ſilver, rather paler, but upon ſtanding, partly of a ſlate color; 5. They give all the other effects of numbers 6, 7, 8, 9, 10, 11. with leſs of the coloring matter and rather more of the ſalt.

§ 309. 4. Ten grains of the dried reſiduum, thrown into an ignited crucible, fumed and flamed; but more ſlightly and ſhortly than that of Thames water. Calcined like that, it did not fuſe; loſſed ſomewhat better than three grains of its weight; changed to a paler aſh-color; and to an abſorbent and lime-like taſte, rather ſlighter, than that of Thames water; § 285. 3.

§ 310. 5. The waſhings of this calx ſtood every teſt of lime water, as well as that of § 286. 6.

§ 311. From theſe experiments and obſervations, it appears in what manner and proportion this water differs from or agrees with the Thames water. The reaſons are ſo obvious, from what has before been ſayed, that pointing them out would be but teadious and unneceſſary repetitions to the intelligent and attentive, by whom alone I can hope to be underſtood.

§ 312. Theſe waters may with ſafety and propriety be uſed, wherever a pure ſoft water is requiſite, for drinking or bathing; for waſhing or bleaching; for dreſſing of food, animal and vegetable; in the ways of baking or boiling; for making malt and for brewing; for preparing medicines by infuſion, decoction, diſtillation, &c. But, for the exact dilution of ſolutions for precipitations; for the waſhing of magiſteries; for dying the tenderer colors; for the accurate cryſtalliſation of ſalts, and the like operations, purer waters ſhould be ſought by the curious operator.

Of HAMPSTEAD WATER.

§ 313. 1. This is partly the product of ſprings and partly rain water collected in ponds about the hills of Hamp-

Hampſtead and Highgate, about four miles from London, and conveyed by pipes, through Kentiſh-town, to certain parts of the town.

§ 143. 2. It is ſeldom quite bright to the eye, till it ſtands ſome time to ſubſide. After rain, it is very apt to be turbid, from the quantity of light clay, waſhed into it from the hills and high ways.

§ 315. 3. Set ſtanding in a glaſs for twenty-four hours, it 1. diſcharges ſome air, in ſmall bubbles, which fly off partly at the ſurface and partly ſtick to the ſides of the veſſel; 2. It lets ſome light ſediment fall, and grows proportionably clearer.

§ 316. 4. The color of ſirup of violets is firſt diluted, then changes to a ſea green, which upon ſtanding heightens. In twelve hours, it becomes yellowiſh.

§ 317. 5. The infuſion of Campechy log-wood gives a pink bloom; upon ſtanding, a little while, heightens ſomewhat; afterwards begins to fade, till in ſome hours it comes to the color of old Canary wine.

§ 318. 6. With cochinelle it gives a very beautiful crimſon, which heightens upon ſtanding, and in twelve hours ſuffers no diminution of color.

§ 319. 7. Alcaline ſalts, concrete and liquid, in double the proportion added to Thames water, work hardly any ſenſible change, upon mixing or ſtanding in this water.

§ 320. 8. The ſolution of ſoap mixes ſmoothly and cauſes a ſlight lacteſcence; but, none other ſenſible change.

§ 321. 9. With the ſlighter vegetable acids, as diſtilled vinegar, it ſuffers no change. With the diluted vitriolic acid, it mixes without any ſenſible commotion; upon ſtanding ſhews ſome air bubbles and ſeems ſomewhat brighter.

§ 322. 10. With the ſolution of mercury ſublimate, upon dropping, no change appears; upon ſtanding it ſeems lacteſcent, and throws up a ſlight, pale, mother-of-pearl-colored pellicle, but ſhews none air. In about

twelve hours, it appeared covered with a ſmooth variegated pellicle; ſhewed no ſediment; but, the glaſs was ſlightly coated.

§ 323. 11. Every drop of the ſolution of mercury cauſed a white milky cloud, which ſoon turned to a pale yellow. This upon ſtanding, precipitated fairly; whileſt a ſlight pellicle of different colors aroſe upon the ſurface.

§ 324. 12. The ſolution of lead cauſed at every drop a pale milkineſs, which, at four, heightened to a pearl-color, without any viſible ſeparation. In twelve hours a pale, ſlight and broken pellicle appeared on the ſurface and an inconſiderable pale precipitate ſubſided.

§ 325. 13. Every drop, as far as four, of the ſolution of ſilver cauſed pale, blewiſh white clouds, which upon ſtirring rendered it all over of a pearl-color. In twelve hours, a blewiſh ſlate colored precipitate thinly covered the ſides and bottom of the glaſs.

§ 326. 14. A gallon of the purified water evaporated in a glaſs bell in a ſand heat, 1. ſhews a good deal of air, which partly ſticks in bubbles to the ſides of the glaſs, and partly flies off, as the water warms; until, 2. a pellicle ariſing upon the ſurface arreſts ſome of them and forms large bubbles, which cover the whole. 3. In the operation, the vapor, that flies off, has an earthy ſmell. 4. As the water exhales, the pellicle coats the ſides of the glaſs, grows higher colored and thicker towards the bottom; where, 5. it makes a circular cruſt of a darker color, in the center of which, 6. A light, thin, paler cruſt appears. 7. Theſe, well dried and collected with all care and caution, weighed four ſcruples and ten grains; 8. Gave a terrene taſte with ſome ſaline acrimony; 9. abſorbed humidity enough from the air to increaſe their weight, in wet weather.

§ 327. Hence it appears, that every pint of Hampſtead water contains eleven grains and a quarter of ſolid matter, which we now procede to examine.

§ 328.

§ 328. 1. This reſiduum, with the ſtrong acid of vitriol, cauſed a ſtrong ebullition with ſome degree of efferveſcence and ſome ſharp, white fumes like thoſe of ſea ſalt, to all ſenſible appearances.

§ 329. 2. In the diluted acid, it cauſed a ſtrong and long commotion; but, was not completely diſſolved.

§ 330. 3. Ten grains of it waſhed with an ounce of pure water and filtrated gave it the tincture of mountane wine, and left in the filtrating paper five grains of a paler, a kind of creme-colored earth.

§ 331. 4. The waſhings at firſt but diluted the color of ſirup of violets, then diſcharged it, and upon ſtanding put on ſome ſhades of a ſea green; 2. cauſed no commotion with acids; 3. with alcaline ley, no commotion, but a milky opacity, and with alcohol, a milkineſs; 4. precipitates the ſolution of quickſilver yellow, and 5. that of ſilver grumous and white; 6. evaporated to a dryneſs it affords phaenomena ſimilar to thoſe of this part of Thames water, § 284. 4. N°. 7, 8, 9, 10, 11. the ſaline reſiduum more apt to run liquid in the air.

§ 332. 5. Ten grains of the firſt reſiduum thrown into an ignited crucible gave but little fumes, of the ſmell of burning bricks; but no flame; ſoon after fuſed and bubbled ſmartly, then ſubſided and run ſmooth, and in about a minute fixed. It loſſed of its weight, in this operation, three grains and an half; and put on the aſpect of a fuſed ſalt, the taſte of which, with ſome lime-like acrimony, it had acquired.

§ 333. 6. The waſhings of this 1. had a ſalt taſte, with ſomething lime-like or lixivial; 2. mixed with acids without any ſenſible commotion; 3. was precipated by alcalies and gave every proof of being a lime water.

§ 334. To offer a compariſon betwixt this and the preceding waters, would be but teadious and unneceſſary; and the etiology of the experiments, would be but a diſagreeable repetition; as the cauſes of the changes,

changes, the difference between this and the other waters, and which deſerves the preference in particular uſes, muſt readily occur to the attentive, who alone can profit by theſe or ſuch like analyſes.

Of RATHBONE-PLACE WATER.

§ 335. 1. This water does not appear perfectly bright to the eye; ſet in a glaſs for ſome hours, it lets fall a ſlight earthy depoſite, and throws up a terrene pellicle upon ſtanding; whileſt it covers the ſides of the glaſs with air bubbles.

§ 336. 2. Sirup of violets has its color firſt diluted, then turns greeniſh, and improves but little by ſtanding.

§ 337. 3. The infuſion of Campechy wood gives a kind of Madeira wine color, which heightens a little upon ſtanding.

§ 338. 4. Cochinelle gives a roſe purple, which holds for ſome time; but, in about twelve hours, ſhews ſome greeniſh clouds precipitating.

§ 339. 5. The ſmalleſt portions of alcaline ſalts, in a liquid or concrete form, cauſe a milky opacity, the later a greater ebullition than ordinary, and upon ſtanding, precipitate a conſiderable quantity of pure, white earth, and throw up a terrene pellicle to the ſurface.

§ 340. 6. Every drop of the ſolution of ſoap coagulates on the ſurface, and being mixed, inſtantly ſuffers a complete decompoſition.

§ 341. 7. With acids, it ſuffers a very ſenſible commotion, throwing off much air in minute bubbles to the ſurface and to the ſides of the glaſs, and becoming more pellucid.

§ 342. 8. The ſolution of corroſive ſublimate, cauſes a conſiderable milky opacity upon dropping, firſt at the bottom of the glaſs, and upon ſtirring, it appears of a pearl colored milkineſs all over. It throws up a diverſicolored pellicle, and in about twelve hours, lets fall a fair, pale precipitate.

§ 343.

§ 343. 9. The ſolution of quickſilver cauſes the ſame appearances, as in Hampſtead water, the clouds more opac, their upper ſurface more white, the precipitation ſooner formed of a deeper color, with a ſtrong, variegated pellicle.

§ 344. 10. Every drop, as far as four, of the ſolution of lead in diſtilled vinegar, cauſed a thick white, milky, opac cloud, which ſuddenly precipated. In twelve hours, the precipitation was complete, of a kind of creme color, and a ſlight pellicle formed on the ſurface.

§ 345. 11. A ſolution of lead in the acid of nitre, which cauſed no ſenſible change in the Thames at high or low water, in the new river water and that of Convent-garden pump, at firſt ſuffered none alteration in this. But, ſoon after ſtirring, it began, upon ſtanding, to coat the glaſs, and in twelve hours, ſhewed a very white precipitate. This the Savoy pump produced more ſuddenly.

§ 346. 12. Every drop of the ſolution of ſilver cauſed opac white clouds at dropping. Upon ſtirring, the mixture appeared of a milky opacity all over; and upon ſtanding, let fall a pale, ſlate colored precipitate in greater plenty, than Hampſtead water did.

§ 347. 13. A gallon of this water committed as the others to evaporation in a ſand heat, as it heated threw off a great quantity of air, which roſe in ſmall bubbles from all the firſt and moſt warmed parts of the glaſs to the cooler parts and to the ſurface of the liquor. As this eſcaped, a pellicle aroſe on the water, which thickened, as the air and humidity diminiſhed, ſo as to be at length able to retain much of the air in great bubbles at the ſurface. The vapor had no remarkable ſmell. The pellicle did not coat the glaſs, ſo thickly or firmly, as that of the Hampſtead water; and the ſolid contents coaleſced in grumes or a kind of roundiſh granules at the bottom, of a pale lute color. Theſe, ſcraped carefully off and well dried, weighed five ſcruples of a more piqnant ſaline taſte, than thoſe

of

of Hampſtead; like which they ſeemed to grow moiſt upon being expoſed to the air.

§ 348. This ſhews, that every pint of the water of Rathbone-place contains twelve grains and an half of ſolid matter.

§ 349. 1. This reſiduum with the ſtrong and dilute acid of vitriol gave the ſame phaenomena with that of Hampſtead waters.

§ 350. 2. Waſhed in the like proportions with pure water, it gave the like tincture, leaving about four grains of a paler earth in the paper through which it was filtrated.

§ 351. 3. Theſe waſhings, more than any of the preceding, tended 1. to change ſirup of violets to a pale green; yet, 2. cauſed no commotion on mixture with acids; 3. with alcaline ley, a milkineſs and precipitation; 4. with alcohol, a great milkineſs; and anſwered all the other experiments made upon the like reſidua of the preceding waters.

§ 352. 4. Ten grains of the firſt reſiduum projected into an ignited crucible fumed and ſmelled the leſt of any, ſooneſt fuſed, bubbled, ſubſided and fixed; loſſed barely three grains of its weight; gave not ſo ſtrong a ſenſe of ſaltneſs or acrimony upon the tongue, as any of the preceding; being more compact and inſoluble. However, its waſhings anſwered all the preceding characteriſtics of lime water; but, was not ſo ſtrongly charged with the lime.

§ 353. The changes with acids, § 341. 7. and the decompoſition of the ſolution of corroſive ſublimate, § 342. 8. diſtinguiſh this from the preceding waters; the cauſe of which is evidently an alcali, as appears by § 351. 3. but, more probably of the volatile kind, ſince N° 2. ſhews it remanes not after evaporation, at leſt in a quantity ſufficient to cauſe a new commotion with acids.

§ 354. It may ſeem a paradox, that this water ſhould at once give proofs of its containing an acid and an alcali: The difficulty will be cleared up, when it is conſidered, that the acid in this and many other ſuch

ſuch like waters is of a volatile nature, and flies off, not onely upon the fire, but in the open air, as is proved by this water's growing ſoft and depoſiting the earth, with which it is charged, by the means of this acid, upon ſtanding in the open air. Of this effect, the proprietors of the works are appriſed; for, they let the water ſtand in a large open baſon before it is taken in by any body for common uſe. After it has thus ſtood, it proves a very uſeful, good water for the ordinary purpoſes of families. But, of this acid and this alcali, a clearer notion ſhall be given in the introduction to the ſecond part of this eſſay.

§ 354. To the water of Rathbone-place works, all the pump-waters, as well as the ſprings, I have yet met with in London and Weſtminſter, bear ſo great analogy, that I can onely find them charged all with the ſame ingredients, but in proportions ſomewhat different. Thus, for inſtance, the public pumps at ALDGATE, in ST. PAUL'S church-yard, in HARE-COURT, in the Temple, in SWAN-YARD, in the Strand, in the SAVOY, in CONVENT-GARDEN Market, at the BANQUETTING-HOUSE, Whitehall, and ST. MARGARET'S church-yard, Weſtminſter, as well as the ſprings of LAMB'S CONDUIT, CROWDER'S well, and POSTERN-ROWE, ſhew none eſſential difference upon any trial. The variations, that are diſcovered, ariſe chiefly from the different proportions, not eſſences, of the compoſition. It would be but tedious here to enter into particulars. I ſhall therefore confine myſelf to ſome of the moſt remarkable, which may excite men of more parts and leiſure to purſue the uſeful enquiry upon the plan here layed down.

§ 355. 1. ST. PAUL'S church-yard-pump, upon evaporation, gives a ſtraw-colored matter, ſixty-one grains to the gallon; that is, ſeven grains and an half and one eighth of a grain to a pint; which matter, 1. abſorbs the humidity of the air, 2. produces analogous effects, with ſtrong and diluted acids, with the preceding.

§ 356. 2. This matter waſhed with pure water, as the preceding reſidua, gave the like tincture, paler; and being filtrated left but three grains of terrene matter, of a paler color than before waſhing, in the coffin.

§ 357. 3. The waſhings produced the like effects with thoſe of Rathbone-place.

§. 358. 4. The firſt matter thrown into an ignited crucible gave the ſame appearances with the reſiduum of that alſo.

§ 359. The SAVOY pump treated in like manner, gave the like products, ſix grains leſs in a gallon; but, this was more ſaline; for, in waſhing, it left but two grains and an half of earth. The reſt being a kind of ſalt. The waſhings were of a pale color; and wrought all the effects of the preceding, fumed, rather leſs; fluxed ſomewhat ſooner, bubbled, ſubſided and gave lime, like the reſt.

§ 360. CROWDER's well evaporated with appearances ſimilar to the pump-waters; but, its reſiduum was more colorleſs than moſt; for, upon the glaſs, it looked more like a ſaline cruſt, than an earthy matter; and being left quite dry upon the glaſs at night, by the next morning, it had abſorbed humidity enough, to appear in large yellow drops upon the ſides of the glaſs, of a very acrid and ſeeming alcaline and lixivial taſte. The ſand being again heated, till it was perfectly dry, the reſiduum, whileſt hot ſcraped carefully off and gathered, weighed four ſcruples from a gallon, that is, ten grains from a pint, and now appeared of a pale olive color of a very ſharp acrid taſte.

§ 361. Ten grains of this, waſhed like the others, 1. gave the ſame kind of tincture. 2. Theſe waſhings gave a tendency to a ſea, and then to a pale green with ſirup of violets; yet, 3. mixed without commotion with acids; 4. was precipitated by alcaline leys, and in ſhort, produced effects analogous to the other waſhings of the preceding reſidua.

§ 362.

§ 362. What remaned in the filtrating coffin, dried, weighed four grains, and became of a pale aſh-color. So that ſix grains of the ten are ſalt, of the ſame nature with the reſt.

§ 363. Projected into an ignited crucible, the firſt reſiduum fumed very little, fuſed, bubbled, ſubſided and gave lime, like the reſt.

§ 364. LAMB'S CONDUIT ſhewed leſs air in evaporating, having been two days drawn, the ſpring being then dry. 1. It gave twenty grains and an half of matter darker colored than any of the reſt, of much the ſame taſte with that of Crowder's well; but ſeemingly more earthy, in that, that it did not run ſo much, or ſo much attract the humidity of the air; 2. it was like the reſt affected with the acids; 3. waſhed like them, it gave an high old Canary wine-colored tincture, which produced the like effects with the other waſhings in general, making allowance for the difference of color; 4. Thoſe left in the paper, through which they were waſhed, above four grains and an half of a much paler earth; ſo that not above five grains, and about a quarter, in ten, were ſalt of the ſame nature with the reſt. 5. The firſt reſiduum projected into an ignited crucible exhibited ſimilar appearances and effects with the others, but fuſed rather more ſlowly.

§ 365. As the ſalt-like ſubſtances, extracted by elixiviation of the reſidua of theſe waters upon evaporation, are not ſufficiently explaned by any one, I have yet met with, it is proper to ſpend ſome time and pains in examining them a little further.

§ 366. The reſiduum of every one of theſe waters, that of rain and of every other water, I know, that does not contain ſome other neuter ſalt, than that of the ſea, abſorbs the humidity of the air in ſome degree, and humects or runs liquid in ſome meaſure, like thoſe, that contain the nitre of the antients or mineral alcali, or rather more.

§ 367. This deliqueſcence or ſolution always has an acrid taſte, as the reſiduum itſelf imprints upon the tongue. From its ſolubility, as well as taſte, one is naturally induced to conclude this a ſalt, and from its abſorbing the humidity of the air, one is prompted, at firſt ſight, to pronounce it, an alcali, as KUNCKEL has, from the like properties, miſtaken the ley or bittern of ſalt water. But, we muſt be cautious in our concluſions. It will be found, that the waſhings of theſe reſidua give ſome portion of ſalt; but, all that diſſolves is not to be looked upon as a ſalt, ſtrictly ſpeaking. When the oily parts are ſeparated by alcohol, or by calcination of the maſs left upon evaporation of theſe waſhings, it then readily diſſolves in water, or by reſorbing the humidity of the air. Then, by evaporation, it will ſhew ſome cryſtals of ſea ſalt; but a great part remanes, that will not cryſtalliſe. If the ſolution be evaporated to a dryneſs, it will not long hold a concrete form; but, will attract moiſture and again run liquid. This, muſt be confeſſed to be one of the characterſtics of an alcali; but, the others muſt concur before any concluſion is drawn. Theſe like leys or ſolutions of fixed alcalies, 1. inſtantly tinge ſirup of violets of a bright green; 2. cauſe an ebullition with, and ſaturation of, acids. But, our ſolution, or theſe waſhings of the reſidua of our waters, 1. hardly change the color of ſirup of violets; 2. cauſe none ebullition with, or ſaturation of, acids: but, with the heavier, as the vitriolic acid, produces a ſelenite, after expelling the marine acid, in perceptible white, ſharp fumes; and, inſtead of mixing without any ſenſible change, as one pure alcali does with another, every alcaline ſalt, whether fixed or volatile, cauſes a fair precipitation in theſe waſhings of our reſidua, of an abſorbent earth, in all reſpects correſponding with that called magneſia alba; and being added, till no further precipitation is cauſed, produces, with fixed alcalies, a purer ſea ſalt, one with a vegetable, inſtead of a mineral

neral alcali to its baſe; and with volatile alcalies, ſal ammoniac. Though then it appears, that our reſidua may contain ſome inconſiderable quantity of ſea ſalt; we may be aſſured, the far greater part is Mater Salis, the mother of ſalt, bittern, well known to our workers in ſalt, whether of the ſea or of our mediterranean ſalt ſprings, which is the acid of ſea ſalt, charged with calcarious earth, inſtead of the mineral alcali; and is therefore a liquor analogous to HOFFMAN's Lixivium Salis and to the Oleum Calcis of the chemiſts, or the liquid ſhell of ſome of our quacks, which is the acid of ſea ſalt, charged with lime, ſhells of fiſhes, or other calcarious earths. Theſe will be found upon every trial to produce analogous effects; ſuch as not keeping a concrete form; ſlightly changing the color of ſirup of violets; mixing without commotion with the light, and giving a ſelenite with the heavier acids; precipitating with fixed and volatile alcalies, &c. &c. &c.

§ 368. The curious, if there be any ſuch, who read this, will probably enquire, whence the origine of this, as well as other parts of the compoſition of our river and ſpring waters?—Whence the waters themſelves, is already made obvious. How they may be differently impregnated with various bodies, has, in our general idea of ſalts, as well as in examining the properties of water in particular, been layed down. The onely difficulty, I apprehend here remaning to be cleared up, is the ſeeming change of the nature of the acid, by whoſe means the water becomes impregnated. The ebullition ariſing upon the dropping the acid of vitriol or others into any of thoſe waters, that of Rathbone-place in particular, might have partly aroſe upon the propulſion of the lighter mineral, natural acid, or the ethereal and elaſtic ſpirit, by the union of the heavier, arteficial acid to the terrene parts, which were by the former at firſt held in a ſtate of ſolution in the water; as well as it might alſo from ſome alcaline principle. This alcaline principle muſt

be of a volatile nature, ſince it is not to be diſcovered in the reſiduum after evaporation. To this the milkineſs and precipitation, with ſolution of ſublimate, may be attributed. That ſuch an alcali is found in the earth, BERGER, HOFFMAN, WALLERIUS, &c. are agreed, as ſhall be ſhewn in the ſequel. This native acid, by which the earth in theſe waters appears diſſolved, is moſt probably of a vitriolic nature, the univerſal acid; as may be judged from its precipitating a ſolution of mercury in the acid of nitre, yellow; as every ſolution of a calcarious earth in the vitriolic acid does; whereas a white precipitation is produced with that mineral thus diſſolved, and a ſolution of theſe earths in the acid of ſalt. The acid of ſalt is judged to be produced by the union of the third earth or mercurial principle with the vitriolic acid. Both the one and the other are plentifully diſperſed throughout the creation. We need not then wonder at it in this water; nor that the acid of ſea ſalt united to this earth may appear after the volatile vitriolic acid, or ſubtil mineral ſpirit of the waters, has been exhaled: For, that this is evidently the marine acid, no doubt can remane from the preceding experiments.

§ 369. By whatſoever means waters become impregnated with earths of any kind, they come under the denomination of hard waters, will be precipitated by alcalies, and decompoſe ſoap. The waters, in which theſe effects have appeared, are of this claſs. But, this containing the marine acid, is leſs liable to produce the evil effects, which attend thoſe of the vitriolic ſolutions of ſuch earths, which give that inſoluble ſubſtance, called a ſelenite, which obſtructs and fouls the glands, and poſſibly contributes to the generating of ſtoney concretions in the urinary paſſages; whileſt thoſe with the marine acid are found to prevent and break ſuch concretions.

§ 370. Hence, theſe waters are not to be dreaded, in theſe circumſtances; but may, with ſafety and propriety, be drank by calculous and gouty patients; and I am well perſuaded, theſe ſprings and pumps will

will be found more truly medicinal, than many of thoſe, that are deemed ſo; and as ſuch, have their ſources much frequented, and their waters tranſported to various remote regions.

Of the medicinal Qualities and Uſes of WATER.

§ 371. It were happy for the moderns, they had kept up ſome degree of that veneration for water, which was payed to it by their more wiſe anceſtors. How uſeful and neceſſary it muſt prove to all the terreſtrial creation, may be eaſily conceived from the premiſſes. It is in an eſpecial manner neceſſary to the animal kingdom, and of thoſe, that can live out of that element, to none more ſo, than to the human kind: in ſo much, that, to me, there ſeems great reaſon to apprehend, that the health, and even the ordinary term of life of man, have ſenſibly declined and ſhortened, in proportion as water has become neglected or diſuſed.

§ 372. The antients looked upon water as the material cauſe or firſt principle of all created things. The firſt philoſophers, who gave this as their opinions, were *THALES MILESIUS, and EMPEDOCLES. They had many followers. Among the moderns, †PARACELSUS ſtarted the ſame doctrine, aſſerting water to be at once the ſeminary and matrix of all created beings, or to contain in it actually, as well as eſſentially, not onely vegetables and animals, but minerals alſo, not excepting the moſt perfect gems and metals. From this rambling philoſopher's opinion, VAN HELMONT did not much vary. And though all theſe, to more cool and better enlightened enquirers, appear to have exaggerated in their notions; yet, all muſt confeſs, that without water, there could be no generation or procreation of any bodies of whatſoever ſpecies in the mineral, vegetable, or animal kingdoms. Hence,

* Diog. Laert. in Vit.

† Param, lib, iii. meteor. lib. cap. 3. de peſt. tr, 1. et paſſim.

ſome wittily, if not truly, derive the etymology of the latin name of water, Aqua, from à qua omnia fiunt; that, out of which all things are produced.

§ 373. The ancient heathen did not think they diſhonored or leſſened their gods in deducing their origine from water.*

§ 374. A great part of the religion of the ancient heathen, as well as of the Jews, conſiſted in waſhing. How far phyſic and good policy contributed to give riſe to the cuſtom of waſhing, eſpecially in hot countries, is not, at this day, eaſily aſcertained; though, it is probable, one or both bore a part in inſtituting that, which religion afterwards more ſtrictly enforced. Be that as it may, it is certain, no perſon, of either perſuaſion, was deemed clean, or judged qualified either to ſacrifice or pray to the gods, who had not firſt been cleanſed and purified by waſhing. Without this, † neither was to expect his prayers or ſacrifice acceptable. Hence, the cuſtom of waſhing of hands became ſo neceſſary a ritual in ſacrificing, that the greek word ‖, uſed to ſignify to waſh the hands, ſerved alſo for the expreſſion, to ſacrifice.

§ 375. The inhabitants of part of the Eaſt-Indies, to this day, pay the ſame religious regard to waſhing. Whence, immerſion in the river Ganges, is looked upon, by them, equal to an expiatory ſacrifice, with others. It is not improbable, the ceremony of ſprinkling with holy water, in the new roman religion, and that of dedicating ſweet, as well as medicinal, ſprings and natural baths, by the votaries of that religion, to ſome of their ſaints, ſprung from the ſame ſource, and in proceſs of time, and ignorance, degenerated into ſuperſtition.

* Ωκεανὸν τε Θεῶν γενεσιν, καὶ μητέρα Τηθύν. HOMER, Iliad. lib. xiv.
Where the great parents (ſacred ſource of gods)
Ocean and Tethys ——— ——— ——— POPE.

† Homer. Odyſſ. lib. ii. and the books of Moſes.

‖ χερνιπτειν.

§ 376. What

§ 376. What or how elementary water may contribute to the generation or accretion of the different bodies of the creation, I ſhall not attempt to explane further in this place. Let it ſuffice to obſerve, that beſides making an eſſential conſtituent part of moſt bodies, it is, undoubtedly, the vehicle of nutrition to all the creation. The beſt philoſophers agree, that all things were ſome time in a fluid form; and we may preſume, it muſt have been aqueous fluidity.

§ 377. No vegetable or animal can ſubſiſt long without water; and it is certain, that, ſince the creation, water has been the common drink of men as well as of brutes. Hence, water may well be reckoned the moſt valuable liquor produced by nature or art. The wiſdom of the Creator appears in none inſtance more manifeſt, than in the vaſt plenty in which he has ſupplied his creatures univerſally with this neceſſary fluid; though moſt of them, even the rational, have been ungrateful and inſenſible enough to forget and deſpiſe his providence and bounty, in making this beneficent, this parent liquor, ſo common.

§ 378. From the creation to the univerſal deluge, which is calculated by divines to have made a ſpace of ſixteen hundred years, we are told, that neither wine, nor any other fermented liquor, was known; ſo that water was man's chief drink during that time. We learn from ſcripture, that men lived then to a thouſand years. I will not preſume to ſay, that this longaevity was ſolely owing to the uſe of water; but, I think it no preſumption to conclude, that, in thoſe days, in which men lived neareſt the ſimplicity, that nature dictates in all her works, they were then moſt healthy, and lived the longeſt. Water was the onely drink the Almighty prepared for his creatures, after a certain age; and had any other been neceſſary, he could not have been wanting. in his unbounded knowledge and providence, in producing it. It muſt be confeſſed the pureſt, the ſimpleſt, the moſt natural, and, I had like to have ſayed, the onely proper drink for all grown animals.

§ 379.

§ 379. Let us conſider the conſequences of having introduced other drinks. Noah, of our ſcriptures, who is agreed to have been the Bacchus of the heathen, is deemed the inventor of wine: With the uſe of which, a worſe deluge than the general, a deluge of luxury and vice, overrun the world. Diſeaſes of body and mind were introduced; ſo that men did not live to above a tenth of the age of the antediluvians. Thus, the royal pſalmiſt in his penitentials, after having perpetrated every vice, that any monarch or ſubject ſince his days could boaſt, and contracted the fouleſt diſeaſes, that ever rendered a libertine's life miſerable and burthenſome, exclames, that the days of man are limited to three ſcore and ten years. Whereby it is obſervable, that the further men receded from the ſimple courſe of diet and manners, which wiſe and provident nature, or her great and omnipotent author, pointed out, the more immoral and profligate they became, and the ſhorter they cut the thread of life.

§ 380. The ancient Perſians, as well as the Parthians, eſteemed water the beſt drink: For, we are told of their kings, that they drank nothing but water; of which they were very chary, as well as cautious in their choice.* Hence, their monarchs reſerved to their own ſole uſe, the water of the river Eulaeus, according to Strabo, and that of Choapſes, according to Herodotus. Of theſe, no ſubject was permitted to drink under ſevere penalties. This author attributes the longaevity of the Ethiopians, who, as he ſays, lived to one hundred and twenty years, to the uſe of their waters, whoſe ſubtility and levity, he obſerves, to be ſo remarkable, that no body, not even wood, could float on them.†

§ 381. The ancient Romans were very ſparing in the uſe of wine. Some of their hiſtorians‖ aſſert, that wine was not drank among them for four hundred

* PLIN. Hiſt. Nat. lib. xxxi. c. 3.
† Lib. iii. c. 125.
‖ JULIUS FRONTINUS.

and

and fifty years after the building of the city. They were then hail, robuſt, vigorous, valiant, and virtuous: But, as riches increaſed, and their attendant luxury crept in, they changed their ſimple way of living for a more ſumptuous: Inſtead of water, they drank wine. And the conſequence was, that in proportion as they indulged in the uſe of wine and other delicacies, ſo they fell off from that happy diſpoſition of body and mind, that rendered them the objects of admiration, envy, and terror of the reſt of the world; they became weakly, ſickly, diſorderly, daſtard, corrupt; and at length, exchanged the two greateſt bleſſings of life for the worſt curſes; health and freedom, for diſeaſes and ſlavery. And thus, we have the teſtimony of former ages concurring with what is obſervable in our days, that the healthieſt, longeſt-lived, and happieſt people, are found among thoſe, that drink water rather than fermented liquors.

§ 382. From this, and many other conſiderations, I am induced to be of the ſame opinion with the learned HOFFMAN, who ſays, that if there be in nature a medicine, that deſerves the title of univerſal, it is water.* This will be rendered more evident by conſidering, with the properties, qualities, and effects of water, the nature and ſtructure of the human frame. Let us then begin with the later conſideration, as the former fell, in part, already under our obſervation.

§ 383. The body of man conſiſts of various heterogeneous parts, and is of a very lax and fragile texture. It is liable to an infinite variety of diſaſters, and hardly ever to be pronounced in a perfect ſtate of health. It ſtands in need of continual ſupplies from without, for its nouriſhment and ſupport; and, as it muſt neceſſarily take in more food, than it can aſſimulate, or diſpenſe withal, it is providentially furniſhed with means of throwing off uſeleſs and ſuperfluous matters, by certain excretory ducts and pores. For theſe purpoſes, it muſt be furniſhed with a great variety of or-

* De Aq. Medicina univerſ.

gans

gans or machines for comminuting, digeſting, moving, ſtraining, applying, uniting, or ſeparating the ſeveral parts of the received aliments, as they are fitted and deſtined to ſupport different parts of the whole frame, and to caſt off redundancies and recrements.

§ 384. This wonderful congeries of machinery, the work of ineffable wiſdom and power, is conſtructed of ſuch materials as this lower creation affords, periſhable matter; ſo that every organ is worn, and in ſome ſenſe injured, by the very function it performs for its own and the general ſupport of the oeconomy.

§ 385. Thus, all the parts of this complicated, yet moſt regular machine, whether they miniſter to the vital or animal functions, the involuntary actions neceſſary to life, or thoſe directed occaſionally by the impulſes of the mind, are all, in ſome degree, worn or impared in the very action. As, for example, the teeth ſuffer in maſtication or chewing the aliments; the tongue and throat in deglutition or ſwallowing; the ſtomach and inteſtines in digeſtion and excretion; the heart and blood-veſſels in the circulation of the blood; the brain in elaborating the nervous fluid or ſpirits; the ſeveral glands in ſecerning their peculiar juices; the lungs in inſpiration and reſpiration; the muſcles and joints in motion; in ſhort, every organ, even the ſeveral ſecretory and excretory ducts and pores, muſt ſuffer in the performance of thoſe very offices, without which the animal can not poſſibly ſubſiſt.

§ 386. This ſtupendous frame conſiſts of ſolids and fluids. The ſolids are all vaſcular, and conſiſt of elaſtic fibres; and as they receive their accretion and nutrition from the fluids, ſo they contain them, and promote their free and equal diſtribution by an univerſal, regular circulation. Thus, the ſupport and preſervation of the whole depends on motion: For, while the fibres retain their due tone, they will receive and propel the contained fluids, and thereby paſs them through all the canals, from the greateſt in the heart

to

to the moſt minute in the extremities, by a ſucceſſive and reciprocal dilatation and contraction. By this regular motion the ſolids nouriſh and repare themſelves, and preſerve the neceſſary fluidity of the juices.

§ 387. While the due tone of the ſolids, and the neceſſary fluidity of the juices are perfectly preſerved, the body muſt ſubſiſt in health. This might be perpetual were not the materials, of which the whole is compoſed, periſhable, ſubject to an infinite variety of viciſſitudes, which, in time, muſt bring on corruption or diſſolution.

§ 388. From the nature of the aliments, and the very air, that ſurrounds and ſuſtains the body of man, the fluids and ſolids are variouſly affected; either by working an immediate change in the juices, which muſt mediately affect the ſolids, or by immediately altering the ſolids, which muſt mediately affect the juices.

§ 389. Whileſt the juices are preſerved of a mild, bland, balmy diſpoſition and due conſiſtency, they furniſh the ſeveral ſolid parts with proper ſupplies; and the ſolids, in their turn, perform their functions uniformly, regularly; but, if they be altered from this due diſpoſition and conſiſtency, and are rendered in any degree acrid, ſharp, and thin, or groſs, viſcid, and thick, an unequal tone of the ſolids muſt be induced, and an unequal diſtribution and circulation of the fluids themſelves muſt ſoon follow. On the other hand, if the ſolids be firſt, or immediately, affected, ſo as a tenſion, or criſpature, or a relaxation of the fibres, be produced; an undue motion of the ſolids will thus be brought about; and the juices, whoſe well being, in an eſpecial manner, depends upon the ſolids duly performing their functions, muſt ſuffer an unhealthful change.

§ 390. By changes thus wrought in the frame of man, foundation is layed for an endleſs variety of diſeaſes, which, ſooner or later, lead to final diſſolution. But, ſhould theſe be avoided to old age, the ſame

end is but more ſlowly brought about; for, the fibres by time grow more ſolid, dry, hard, and rigid, the veſſels are, of courſe, diminiſhed, and the pores contracted. Hence, the fibres gradually abate of, and at length totally loſe, the faculty of motion; by which alone the juices may be circulated for the mutual ſupport of the whole. That this hardneſs and rigidity of the fibres, &c. is brought about, appears not onely from the view and diſſection of old bodies, in which the ſkin is hard and dry, many vaſcular parts are found quite ſolid, and not only cartilages and tendons, but ſeveral portions of the arteries themſelves, are converted into ſolid hard bones,* but alſo from a well known obſervation in cookery, that the fleſh of old animals requires longer time to boil, bake, or roaſt, than that of young.

§ 391. From this ſhort ſketch ofphyſiology, a rational idea of the cauſes of health and diſeaſes of the human body may eaſily be conceived; and the operation of medicines, which depends not upon their activity alone, but is the joint reſult of a mutual, mechanical action and reaction of the remedies and the animal oeconomy: For, did the operations of medicaments depend ſolely upon their power of acting, the ſame effects would be produced in all bodies alike, even in dead, as well as living ſubjects; the contrary of which our common ſenſes evince. Hence, appears the groſs impoſture of thoſe, who pretend to an univerſal medicine, that is, one remedy capable not onely of preſerving the health and life, but of curing all diſtempers and diſeaſes incident to the human frame; and for this purpoſe give their pretended remedies, indiſcriminately to all, without regard to differences of ſexes, ages, conſtitutions, climates,

* Of this, I have a remarkable inſtance by me; the great artery of an old ſubject I diſſected, under the conduct of that minute anatomiſt, great phyſician, and excellent man, M. PETIT, in Paris, of which ſeveral portions, even of the crural branches, are completely oſſified.

ſeaſons

ſeaſons of the year, or other circumſtances. How hardly do they deſerve to be undeceived, who ſuffer themſelves to be duped by ſuch impoſtors!

§ 392. Let us now examine what clame water may lay to the titule of an univerſal remedy. It is certainly, of all known creatures, that, which has the faireſt pretenſions to that appellation; ſince it is demonſtrable, that nothing is found ſo generally uſeful and beneficent, ſo neceſſary to the preſervation of the health and life of man, and ſo inſtrumental to the cure of the variety of diſeaſes to him incident, as water. In a general view, water may well be looked upon as the univerſal medicine. In one ſhape and proportion or other, it agrees with all temperaments, ages and ſexes; may be taken, more or leſs, in all climates and ſeaſons; and without it, in ſome form, no man or other animal can ſubſiſt. Then, in all diſeaſes, whether acute or chronic, when properly applied, it is found a moſt excellent, a moſt powerful remedy, and equally anſwers the preſervative and curative indications.

§ 393. But, it merits a more particular attention. The ſuſtenance of the animal body depends upon the comminution or ſolution of the more ſolid aliments; whereby they are fitted to be carried through the various infinitely ſmall ſtrainers and tubes of the body, and applied to the ſeveral parts and uſes of the oeconomy, for which they are deſtined by the laws of nature. This cän onely be done by the means of water; as that is found the moſt univerſal ſolvent of the food of man and other animals. Then, as the fluidity of the juices of the beſt nouriſhed body, on which their equal diſtribution and free circulation depends, muſt be owing to water; the fitneſs and neceſſity of this liquor, to all conſtitutions, to all ages, to both ſexes, and in all ſeaſons and climates, muſt evidently appear.

§ 394. The blood, that heterogene maſs of humors, from whence, not onely all the other fluids of the body are ſecerned, but the moſt hard and ſolid

parts

parts derive their origine and continual ſupport, conſiſts of ſubtil terrene, oily and ſaline parts, blended with a very conſiderable quantity of water, and by motion kept in ſo fluid a ſtate, as to be capable of paſſing through veſſels too minute for deſcription; but, upon ſtagnation, moſt apt to ſuffer a ſeparation, to run into grumous coagulations, to form obſtructions in the veſſels, to corrupt and putrify.

§ 395. Upon diſtilling or evaporating the blood of an healthful perſon, in an heat not exceeding that of boiling water, it will be ſeparated into two parts, the one a black, hard, ſolid, and hardly ſoluble maſs, which by its inflammability proves its containing oil, and being burned, by elixiviation yields, a ſimple earth and a ſalt, analogous to ſea ſalt. This makes one part of the maſs. The other is pure inſipid water, ſlightly ſmelling of the blood, and conſtitutes two parts of the whole. Thus, twelve ounces of blood, by this treatment, is commonly found to contain about four ounces of this mixed ſolid matter, and about eight ounces of this ſimple water.

§ 396. The health of the body depends upon the due proportion and intimate mixture of theſe materials in the blood. The redundance of any, eſpecially of the ſolid parts, lay an immediate foundation for ſome diſeaſe; the want of any, eſpecially the aqueous parts, alike brings the body to a diſtempered ſtate. Health depends upon the equilibrium being preſerved; but, the oeconomy can beſt diſpenſe with the redundance of water: If the ſolid parts preponderate, all the animal functions in general ſuffer; the circulation becomes languid and unequal, the juices ſizey and viſcid; obſtructions, tumefactions, indurations of the bowels and glands are formed; inflammations, general or partial, are brought on, ſubject to apoſtemation, perhaps, to gangrene and ſphacelation. This evil is remedied by reſtoring its due proportion of aqueous humidity to the blood. By this, the humours acquire the juſt and neceſſary

neceſſary fluidity, a free circulation and all the animal functions are reeſtabliſhed; the veſſels are dilated and opened, obſtructions removed, tumors and indurations reſolved, the ſecretions and excretions promoted; the predominant or diſproportionate ſolid matter, which is to be deemed foregne and noxious, whether terrene, ſulphureous or ſaline, is diſſolved in its proper diſſolvent and waſhed and carried off by the proper emunctories.

§ 397. Thus we ſee, it is water, that diſſolves or liquefies our ſolid aliments and extracts from them the Chyle, from whence the maſs of blood is formed. It is water, that preſerves all the juices in a liquid ſtate, in which alone a free and vigorous circulation of them can be ſupported. By ſuch a circulation, the matters fit for the accretion and nutrition of the different ſolids are depoſited and applied to the deſtined parts; the moſt ſubtil nervous fluid, the cauſe of motion and ſenſation, is elaborated and ſecreted; whileſt all foregne, or uſeleſs matters, all redundancies and recrements are excreted.

§ 398. Hence, it is eaſy to conceive what this ſimple, and too much deſpiſed liquor does and may contribute to the ſuſtenance of human life, to the preſervation of preſent, and to the reſtoration of loſſed, health; and why water drinkers in general are more healthy, vigorous, and cheerful, more prolific and longer lived, than thoſe, who uſe wine and other fermented liquors for their drink.

§ 399. This is obſervable, not only in the poor of all countries, as well as our own, whoſe penury prevents the uſe of fermented liquors; but alſo in thoſe of better condition in other countries, who have the prudence to make water their principal drink. Thus it is in Italy, Spain and France, where the well bred youth of either ſex are hardly allowed or known to taſte wine, and it is a reproach to any grown perſon to drink much. Water, either pure or ſlightly tinged with wine, is the common draught of perſons of

the beſt quality at their meals. Nor are they, like us, afraid to drink water after Fiſh or Fruit, of which they eat more than we do; and yet find water agree better with them, than fermented liquors with thoſe, who are led by a kind of hereditary infatuation into the uſe of pernicious ſpirituous draughts, not onely at meals, but at all hours between them. This ſhameful charge, with all its deſtructive conſequences, falls to the lot of Germans, Dutch, Britons and Iriſh.

§ 400. Thus far we have conſidered water as it contributes to ſuſtain the life or to preſerve the health of man. Let us now conſider how far it is or may be inſtrumental in the cure of the diſeaſes incident to the human frame, in reſtoring loſſed health.

§ 401. Phyſicians diſtinguiſh all diſeaſes into acute and chronic. By acute, thoſe diſtempers, whoſe acceſs is ſudden, and whoſe progreſs is rapid, violent and dangerous, terminating happily or unhappily within a certain ſtated ſpace of time, are underſtood. Of this claſs are all Fevers, which terminate on certain critical days. The idea of a Fever conſiſts in a violent and preternatural motion of the ſolids, whereby the Fluids are neceſſarily propelled with unnatural and intolerable Velocity. This is always an effort of nature to ſhake off ſome noxious or morbific matter; in which ſhe either ſuccedes, and the patient recovers; or fails, ſo that he either dies, or gets through with ſome parts ſo vitiated, as to lay foundation for diſeaſes of the other kind, within a certain term. If by proper evacuations, ſuch as by Veneſection, where the blood is peccant in quantity as well as quality, by emetics or purgatives, where the firſt paſſages are affected, or by diaphoretics, where the ſubtil poiſon may be diſcharged by the pores of the ſkin, and theſe timely applied in the beginning of the diſeaſe, the patient be not relieved; then the chief help, the phyſician can give, is to reſtrain the violence of the motion or furniſh the oeconomy with ſuch matter, as will render the violent and inordinate motion leſs injurious and

more

more tolerable. The method of doing this, nature herſelf generally points out. As by motion, heat is produced, and by that heat, raiſed beyond due bounds, the friendly balmy fluid, neceſſary to keep the common maſs of humours in a fluid ſtate, muſt be altered, waſted or diſſipated; the patient grows thirſty and calls aloud for water or watery liquors to drink. Water is then, his principal, if not ſole, remedy: This corrects the heat, cools and thins the blood, ſoftens and lubricates the arid and criſp ſolids, diſſolves and waſhes off foregne and noxious matters, and, in ſhort, reeſtabliſhes the vital and animal functions, and reſtores deſired health. Hence, the moſt obſervant and judicious phyſicians, whether antient or modern, have always layed a great ſtreſs on the plentiful drinking of water, either ſimple, or ſlightly medicated with ſome convenient vegetable ſubſtance, in the form of Ptiſans or Apozemes, in all ſimple Fevers; with this caution, that it ſhould not be given too cold. Were not this one of the beſt, the moſt univerſal of remedies, what muſt become of the poor in this and other nations, where they can not often procure any other medicine, and are ſometimes forced to rely on it for their principal ſupport?

§ 402. Chronic diſeaſes are ſuch, as are ſlow in their acceſs and progreſs, and continue long, without any ſtated time of determination. Theſe generally ariſe from a fulneſs and viſcidity, or ſome particular impurity of the juices, gradually induced, which brings on obſtructions of the bowels and glands, unequal and imperfect circulation, ſecretion and excretion. Such are the ſcurvey and ſcrophulous diſorders, the ſtone and gravel, the gout and rhumatiſm, &c. for the whole train of which, water has been found the moſt potent, the moſt univerſal remedy.

§ 403. Of this, further proofs and inſtances ſhall be offered in treating of the mineral waters, which have been found moſt effectual in many chronic diſtempers. That their efficacy did not depend upon

their ſolid contents, whether terrene, metalic, ſulphureous or ſaline, may be judged from theſe conſiderations, 1. that ſuch contents given without being diſſolved in, and diluted with, a conſiderable quantity of water, would prove fruitleſs, if not hurtful. 2. That many of the moſt ſimple ſprings and baths have been found ſovereign remedies in a great variety of chronic affections. This has proved a fatal ſtumbling block to many practitioners in Phyſic; who, being ignorant of the qualities and effects of ſimple water, in order to enable them to conjecture the qualities, or to explane the effects of ſuch waters, by the operation of ſome drug, with which they might have had ſome ſlight acquaintance; have tortured their own brains and the waters of divers healthful ſprings to find out or aſcribe principles to them, which the wiſe Creator never gave them. Thus, a medly of all the mineral kingdom, a chaos of ſalts, as ſome * call it, were given to the waters of Aken; ſulphur, bitumen, an alcaline ſalt, and nitre, to thoſe of Bath; Allum and Lime-ſtone, to thoſe of Briſtol; Nitre to thoſe of Scarborough, Cheltenham and other purging ſprings, and mercury to the periodical baths of Pfeffer, &c. the falſehood and abſurdity of which, we ſhall ſet forth in treating of theſe waters ſeverally. But, to ſhew, that ſimple ſpring water, either cold or heated, in its paſſage through the earth, is found a powerful remedy in many inveterate chronic diſeaſes, let us attend to the effects produced by thoſe ſprings, to which the ſuperſtitious reſort, expecting aid from the tutelar or imaginary preſiding ſaint, to whom the waters are ſuppoſed to be conſecrated. To theſe, let us add thoſe famous waters mentioned by HOFFMAN in the tract before cited; ſuch as the pure, light, ſimple waters of Schleuſingen in the Principality of Henneberg, in Germany; by which the Gravel and Stone, Gout, Rheumatiſm, Scurvey, ſtiffneſs and weakneſs of the joints and limbs,

* Blondel, de Therm. Aquiſgr. & Porcet. and his followers and tranſcribers.

and

and obſtructed Menſtrua and Hemorhoids are relieved; the like waters not many years diſcovered in the Black Foreſt near Oſterod, which, upon examination, afford not a grain of any ſolid mineral matter; yet, are found effectual in the preceding diſtempers, as well as in inveterate diſorders of the head, weakneſſes of the limbs and choleric and hypochondriac affections. To theſe may be added the Baths of Toeplitz, in Germany, the famous thermal waters of Pfeffer, in Switzerland, which we have already mentioned, as none other, than ſnow water warmed by a ſubterranean heat; for, they are found void of mineral ſpirit, as well as of all ſolid matter; yet, they are powerful remedies for all diſorders ariſing from mucous, ſaline or tartarous concretions, as contractions or rigidity of the joints, gravel and ſtone, ſcurvey, gout and rhumatiſm, &c. And notwithſtanding, theſe waters are as ſimple and pure, as any water can be conceived; they are ſoft and light, as rain water; and have no more appearance of mineral ſpirit, of ſalt or ſulphur, or other terrene matter, than that: They ſuffer no change upon the addition of acids or alcalies, nor cauſe any precipitation upon the mixture of ſaline or metalic ſolutions.

§ 404. The ſame may be ſayed of a bath in Heſſe, called das Schlangenbad, the ſerpent's bath, as alſo of the waters of Piſa, Tettuccia, Noceria, and many others in Italy; as well as of a remarkable ſpring in Iceland, whoſe heat is equal to that of boiling water, though it be as ſimple, as that of rain.

§ 405. We ſee then, that reaſon and experience demonſtrate the extenſive, the univerſal uſe of water in food and medicine. It was deemed a ſubject to write on, worthy of the pens of many of the antients, as well as * Hippocrates, who wrote expreſly on water.

* De Liquid. uſu. et De Aere Aquis & locis. Quicunque artem medicam integre aſſequi velit, primo temporum anni rationem habere debet, deinde ventorum, qui cuivis regioni proprij. Neque negligentio-

rem

And certainly, that phyſician, who is unacquainted with the nature and quality of waters in general, eſpecially of thoſe, that are uſed where he practices, is but poorly furniſhed with means of preſerving or reſtoring the health of his patients.

§ 406. If authority be wanted to ſupport the uſe of ſimple water in numberleſs diſeaſes, it may be had by conſulting the works of the graveſt and beſt practical writers.

§ 407. RIEDLINUS, an author cited by HOFFMAN, recommends water in melancholy madneſs; and ſays, that rain water, taken like mineral water, firſt in a ſmall quantity, increaſed gradually to a conſiderable pitch, continuing it ſo for ſome days, and then gradually diminiſhing it, cures cachectic and conſumptive perſons.

§ 408. RIVERIUS [a] ſays, that by the continued uſe of ſimple water alone, he has known the ſuppreſſed menſtrual courſes reſtored, better than by more pompous emenagogues.

§ 409. CELSUS [b] earneſtly recommends the uſe of cold water in diſorders of the head, as the mur, or ſtuffing of the noſe, bleardneſs or inflammations of the eyes, defluxions on the glands of the throat, &c.

§ 410. SYLVATICUS [c] warmly recommends it in red and pimpled faces and other erruptions of the ſkin, and in choleric heats of the liver.

§ 411. So effectual has ſimple water been found in the gout, in France, that it is called the Capucin's remedy; becauſe the Friars of that order, by water-drinking, keep clear, or cure themſelves, of that diſorder. Agreeable to this, is what MARTIANUS in his commentary on HIPPOCRATES aſſerts; Cardinal

rem ſe circa aquarum facultates cognoſcendas exhibere convenit. Quem admodum enim guſtu differunt et pondere et ſtatione; ſic quoque virtute aliae aliis longe praeſtant; has, ſi quis ad urbem ſibi incognitam perveniat, diligenter oportet ſcrutari.

[a] Oper. lib. iv. c. 24. [b] Lib. i. cap. 15. [c] Cap 1. Obſ. 1.

Ber-

Bernerius his having been perfectly cured of the gout, by drinking cold water onely. To this RONDELETIUS [a] ſubſcribes, when he aſſerts, his having cured many perſons of the gout by plentiful drinking of cold water; which ſucceded beſt in thoſe of bilious habits.

§ 412. But, as cold water may be diſagreeable and hurtful to perſons of cold conſtitutions and weak nerves; for ſuch, either the natural hot ſpring water, and next to theſe any ſimple waters warmed are moſt proper. Theſe are countenanced by AVICENNE [b]. Such waters taken upon an empty ſtomach muſt be ſerviceable in all diſorders ariſing from a foulneſs of the inteſtinal channel, or a thick and viſcid ſtate of the juices.

§ 413. Let no man be deceived in attributing ſolely to the herbs or other drugs, with which water is impregnated, ſometimes diſguiſed, in Apozemes, Decoctions or Infuſions, or to ſprings ſlightly tainted with minerals, the effects, by the compoſition produced. Such Drugs given by themſelves would often be found, as ineffectual, as the ſolid contents extracted from mineral waters are obſerved. Their efficacy is chiefly, if not ſolely, owing to the water alone; and in many caſes, ſimple, pure water would be found to produce the ſame or equal effects, with theſe more pompous compounds. Yet, ſuch have their uſes in many caſes, where ſomething well adapted to the patient's particular caſe, may be conveyed by the means of that moſt univerſal ſolvent and excellent vehicle, water.

§ 414. Moſt chronic and many acute diſeaſes deduce their origin from a Plethora, or fulneſs. This is beſt prevented or cured by the uſe of water: For, by thinning or diluting the blood, it prevents thoſe morbid coagulations and concretions, which lay a foundation for all diſorders ariſing from obſtructions; or, by diſſolving them when formed, fit them for circulation, and waſhes away all impurities and ſaline recrements

[a] Prax. p. 611. [b] Lib. i. Sect. 2. c. 16. p. 102.

from the maſs of humors, determining them by the moſt convenient emunctories.

§ 415. To facilitate the natural diſcharges, water ſoftens and opens the ſecretory and excretory tubes in general, and thereby promotes the rejection of all uſeleſs or offenſive matters in them contained. It keeps the body duly lax and free, promotes urine, and by waſhing and cleanſing the urinary paſſages, prevents calculous concretions. Water, at the ſame time, that it keeps all the humors in due fluidity, opens and cleanſes the pores of the ſkin, by which tranſpiration, of all others the moſt beneficent and neceſſary evacuation, is regularly kept up.

§ 416. From theſe conſiderations, it is not difficult to conceive how water becomes uſeful and neceſſary in all conſtitutions, to all ages, and to both ſexes. In ſanguine habits, it keeps up ſuch a fluid ſtate of the maſs of humors, as is neceſſary for a free circulation; without which, ſuch muſt be conſtantly expoſed to obſtructions and inflammations. In the choleric, it attemperates the inordinate motion and conſequent heat of the ſolids, by blunting and correcting the acrimony of the juices, and promoting a diſcharge of the redundant ſaline and ſulphureous parts by the proper excretory pores and ducts. By thinning and reſolving the viſcidity of the blood, it remarkably helps the melancholic and phlegmatic.

§ 417. Water not onely agrees, but is neceſſary to the well being of man in all ages. Infants are ſubject to many diſorders from the viſcidity and aceſcency of the milk, which makes the chief part of their diet. In the puerile ſtage of life, various diſorders ariſe from a viſcidity of the juices, occaſioned by the redundance of nouriſhment: In the adult or manly age, we are expoſed to the like diſorders, and to inflammations and fevers; and in old age, the fibres are apt to grow rigid, the ſmall tubes and pores become ſolid or obſtructed, and all the vital and animal functions become languid and irregular. In all

theſe ſtates and caſes, water muſt give the moſt powerful help; for reaſons, which, I hope, are obvious from what has been before offered.

§ 418. Water is well appropriated to either ſex, whoſe diſorders, in general, requires a ſimilar treatment, as the organs, which perform the vital and animal functions, are in both alike. In either, the obſtruction of the menſtrual, or ſuppreſſion of habitual hemorhoidal, fluxes, alike brings on dreadful diſorders. In both, theſe diſcharges are effectually reſtored by a proper uſe of water.

§ 419. Water then ſhould be drank at meals from the infant ſtate to the laſt ſtages of life. In general, the quantity ſhould not be leſs than triple the weight of the ſolids conſumed. As a medicine, in all proper caſes, it may be drank to aſſuage heat and thirſt, to cleanſe the firſt and ſecond paſſages, to dilute the blood and other juices, and to take off the tenſion of the ſolids; beginning with ſmall quantities, increaſing them gradually, till they are found to anſwer, and then diminiſhing the doſe in the ſame time and proportion, as it was augmented.

Of the topical uſes of Water.

§ 420. Hitherto, we have conſidered the internal uſe of water. Let us now examine it as a topical application, in which we ſhall not find it much leſs effectual, or leſs univerſal.

§ 421. As it is probable, the firſt diſorder known to man was local and external, ſome foulneſs or injury of the ſkin, ſtrain, bruiſe or wound, and water preſented itſelf in moſt places, it is likely, that this benign fluid was the firſt topical application. Its uſe in medicine, as well as food, no doubt, became early known to man. Nor do we find the brute creation ignorant of its uſe in either intention. The moſt antient writers in the healing art mention bathing, warm and cold, as a well known and proved remedy. And

there

there is hardly any credible account of any people on the globe at any time ſo rude and barbarous, as not to know the uſe of bathing.

§ 422. We have before touched upon the antiquity and univerſality of the cuſtom and uſe of waſhing. It is not here neceſſary to expatiate much further on that ſubject: The medicinal, not the ritual or religious, uſe of water is the object of this diſquiſition. We find then, in all countries and in all ages, of which we have any authentic hiſtories, Bathing was held in univerſal, high eſtimation. Thus, in every city in antient Egypt, magnificent baths were built for public and private uſe. The Greeks followed the example of the Egyptians, as the Romans afterwards embraced that of Greece. By bathing, theſe people ſought the preſervation of preſent, and the reſtoration of loſſed, health. Nor were they fruſtrated in their expectations: For, theſe ends were eaſily anſwered to a frugal, moderate people; and the good effects of theſe ſalutary applications were obſerved and recorded by the moſt antient writers, and the practice, by them authoriſed, handed down to poſterity; as may be ſeen in the works of HIPPOCRATES, GALEN, ARETAEUS, TRALLIAN, AETIUS, CELSUS, CAELIUS AURELIANUS, &c.

§ 423. The Greek and Roman luxury appeared in nothing more evident, than in the magnificent ſtructures, they erected for their Baths. It has ever been the fate of the moſt powerful remedies, that men could not be contented with the uſe of them upon extraordinary occaſions and in caſes of neceſſity onely, but they muſt luxuriouſly introduce them into the common oeconomy of life. Thus wine, and other fermented and ſpirituous liquors, tea, ſnuff, and many other uſeful creatures, are, by their abuſe, in our days, ſo perverted, as, at beſt, to be rendered uſeleſs to thoſe who are accuſtomed to them, and too frequently to be found deſtructive. This, ſoon after their eſtabliſhment, became the fate of baths: It was no ſooner made known to be neceſſary, to the preſervation

vation and reſtoration of health, to bathe on certain times and occaſions, than every one ran into the promiſcuous uſe of the pleaſing application. Hence, the Emperors and other great perſonages raiſed thoſe ſuperb ſtructures to adorn their baths, of which we find mention made, not onely by the Poets, by Statius, Martial, and others, but by more grave and ſerious writers, ſuch as SENECA[a], PLINY[b], and VITRUVIUS[c]. Of this kind of building, ſeveral great ruins ſtill remane in Rome and Italy, monuments of the luxury, as well as magnificence of their founders. In proceſs of time, baths became chiefly uſed for pleaſure and recreation; as we find Charlemagne received his levee in a great bath, in his favorite city, Aken. Such abuſe could not fail of bringing baths to diſcredit and diſuſe. As this too frequent and promiſcuous uſe of them muſt have often produced evil, as well as good, effects.

§ 424. But, though the abuſe of the beſt medicine ſeldom fails of bringing it into general diſrepute; phyſicians ſhould procede upon more rational principles, than to ſuffer little, mean popular caprices to affect their practice, or diſcountenance the uſe of theſe good things, which reaſon and experience recommend. When they have the teſtimony of the wiſeſt of all ages and nations to convince them of the ſalubrious uſe of rational bathing, how can they ſuffer themſelves to be diſcouraged from the uſing it, by any evils produced by its abuſe! Let it not be aſked—Phyſicians are but men. Phyſic is become a trade; and ſince it became ſuch, it has too often fallen into the hands of mean, ſervile and mercenary men, to eſcape the deſpicable frauds and artifices, that have over-run moſt of the trades and employments of life. The public is ever captivated with novelty, and ever reveres things ſeeming ſecret and myſterious. Hence, as new modes and faſhions become the life of trade, Phyſic, the no-

[a] In Epiſtol. [b] Hiſt. Natur. [c] De Architectura.

bleſt

bleſt art known to man, has been made to ſtoop to the ſame vile craft and artifice, and to put on the ſhameful maſk of obſcurity, to ſerve the ſame baſe ends,—ſordid gain!

§ 425. In ſuch a general degeneracy, it is eaſy to conceive how medicines riſe and fall in common eſtimation, and ſuffer a rotation of faſhions like our cloaths. The frauds and impoſitions, the horrid train of ignorance, which neceſſarily attend this baſe practice, muſt be obvious to the meaneſt capacity. In theſe days, it is no wonder, we find numbers of phyſicians entire ſtrangers to the nature and qualities of ſome of the moſt valuable ſimples, and not daring, where they happen to know and eſteem a ſimple, common medicine, to preſcribe it; when they ſee vulgar prejudice take up arms againſt it, or find the popular folly ſuch, as to eſtimate the value of the phyſician, as is frequently the caſe, from the rarity, expence, or complicated preparation, or perhaps the inſinuated or imagined myſtery of the medicine, he preſcribes; or to make men run after a jugling ſecret-monger, who is not, in knowledge or rationality, three degrees removed from the brute, that draws the gilded chariot, in which he rides triumphant over phyſic, truth and common ſenſe. Who, in ſuch times, will preſume to preſcribe a plane, ſimple remedy, familiarly known to old women and nurſes? — The ſenſible, judicious, honeſt phyſician, who prefers the good of his patient and the peace of his own conſcience to riches, or the favour of a populace, which are too rarely obtained by better arts, than temporiſing, adulation, and ſervility. Had the phyſical world been better ſtocked with men of this caſt, or the populace more diſcerning, we ſhould ſee fewer quacks and other knaves make fortunes by the ſpoils of a deluded people; and medicines would not be rated by their rarity, or, as men are often, by the tinſel on their garments, the magnificence of their houſes, or the ſplendor of their equipages. Had a due regard to the intrinſec worth, not outward appearance, of medicines been

been kept up, water, now deſpiſed from its commonneſs and plenty, would have the firſt rank in the materia medica. How far it deſerves this claſs, we have endeavored already to ſet forth in part, in ſhewing the internal uſe of this element, and we ſhall further evince in explaning the various internal, as well as external diſorders, that are curable by the outward application of water.

§ 426. Water is not much more neglected in the internal uſe, than external application. To this, the former motives too much concur. But, another of the cauſes of the diſuſe of this moſt powerful, though common remedy, in the relief of inward diſorders eſpecially, ſeems owing to modern phyſicians laying out more time and pains in inveſtigating the nature and ſtate of the juices, than in examining, or attending to, thoſe of the ſolids. Had it been duly conſidered, that the free and equal circulation and diſtribution of the blood and juices in general depend upon the due elaſticity and vigorous tone of the fibres of the ſolids, as well as on the fluid and balmy temper of the juices, and that a more ſpeedy change may be often wrought in the ſtate of the ſolids by external, than internal remedies; water, which of all other creatures is beſt qualified to produce ſuch a change expeditiouſly, could not have loſſed ground in practice or the eſtimation of phyſicians. We ſhall in the ſequel endeavor to ſet this important, but much neglected matter, in a proper light.

Of BATHS *in general.*

§ 427. Among the antients, there were various kinds and methods of bathing, which were either cold or hot, moiſt or dry.

§ 428. 1. The cold baths were always moiſt, conſiſting of cold, ſimple water, for the moſt part; though ſometimes, ſaline, chiefly ſea, water was uſed.

§ 429. 2. The hot baths were humid or moiſt, and dry. The humid or moiſt were chiefly ſimple

water, arteficially warmed, or ſimple or mineral water naturally heated in its paſſage through the earth in various Thermae or natural baths. The dry were alſo natural or arteficial; ſuch as Inſolation, or being expoſed to the heat of the ſun; ſalt or ſand heated by the ſun or by an ordinary fire; hot vapors iſſuing from mines; ovens and ſtoves, built for the purpoſe and heated by art; in which bodies were conveniently placed for the diſcharge of ſuperfluous humidity by the pores of the ſkin. To theſe may be added, Baths of fermenting or putrefying Horſe dung, or of preſſed or fermenting grapes, which are uſed in ſome countries, in chronic caſes, with great ſucceſs; and the Vapor Bath, that of any ſimple water duly heated, plane or impregnated with any appropriate medicine; or the vapor of ſome natural bath, charged with a ſubtil, volatile ſpirit, or with the eſſential principles of ſulphur, as the Baths of Aken, or Aix la Chapelle.

§ 430. In this place, it would be improper and foregne to our purpoſe to treat of any other, than the humid bathing, or the various manners of applying ſimple water to the human body externally, for the preſervation or reſtoration of health. In what eſtimation this remedy was held among the antients may be collected from [a] HIPPOCRATES, [b] GALEN, [c] ORIBASIUS, [d] STRABO, [e] PLINY, and others.

§ 431. The waters, which have been in uſe from all antiquity for bathing, are the different kinds of terreſtrial waters; thoſe, for example, of Springs, Rivers, Lakes, or the Sea. Of thoſe, baths may be had or made of any degree of cold or heat, that is required. I ſhall here onely conſider them, as 1. cold, 2. temperate, 3. tepid or hot; and then add ſome account of the Vapor bath, its uſes and effects.

[a] De Liquid. uſu. [b] De tuenda valetudine. [c] Lib. vi. cap. xxvii. [d] Geograph. lib. xv. [e] Nat. hiſt. lib. xxix. c. 1. lib. xxxi. c. 3. &c.

I. *Of the Cold Bath.*

§ 432. Whoever would conceive a rational notion of the operation and effects of any medicine, muſt firſt be well acquainted with the ſtructure and uſe of the parts of the body, with the animal oeconomy in general, with the frame and nature of the part in particular, to which it is to be applied, as well as with the quality of the medicine itſelf.

§ 433. The fibres, of which the veſſels and other ſofter ſolids of the animal body are compoſed, are of an elaſtic or ſpringy nature, and ſo exquiſitely ſenſible, that they are every inſtant changing their tone, growing more tenſe or lax, as they come to be affected by the alterations conſtantly wrought in the animal juices, they contain, or in the atmoſphere, that ſurrounds them. Thus, the tone of the fibres of an animal is never at a ſtand; but more variable, than the beſt conſtructed thermometer, in which the liquid is never found at reſt. The brute creation ſenſibly feels the effects, the changes of the atmoſphere produce on them, and diſcovers it to the obſervant: Ruſtics foretel the changes of weather, particularly to wet or dry, by obſervations on the deportment of their cattle and fowl, which are always found to lick and ſmooth their coats, or feather themſelves, at the approach of rain, before any of our arteficial machines can meaſure the change. Theſe creatures feel an itching, or ſome certain ſenſation on the ſkin, upon this alteration of the air, which makes the one lay its fur ſmooth by rubbing or licking it; and the other ſqueeſe, with its beake, a gland in the rump, which ſecerns, and, upon compreſſion, diſcharges an oily or unctuous ſubſtance, with which they beſmear their feathers, ſo as they may be leaſt affected by the impending rains.

§ 434. The whole animal frame is made up of fibres of this kind. Theſe fibres are moſtly vaſcular. The veſſels, they compoſe, are twofold; 1. Arterial; and

and 2. Venal. The 1. or arterial are theſe which carry the maſs of humours from the heart, or center, to the extremities, for the nutrition of the ſeveral parts and the elaboration or ſeparation of other juices, from the general maſs for the uſes of the oeconomy. The 2d. or Venal are thoſe, that carry the ſuperfluous maſs, ſpoiled indeed of all that is neceſſary for the forementioned purpoſes, back again to the heart and lungs, by paſſing through which, it is as it were renewed, repleniſhed with ſubſtances ſimilar to what it before loſſed, which it beſtows in its courſe, as before, upon the ſeveral parts in its paſſage. This is called the Circulation of the blood, the happy diſcovery of our immortal HARVEY.

§ 435. Beſides the very minute tubes, by which the arteries and venes communicate, each have certain other tubes exquiſitely ſmall appertaining to them. Theſe tubular appendages terminate or begin in the ſkin, and conſtitute that innumerable and inconceivable number of perforations of the ſkin, which are called the Pores. Theſe ſubtil ducts are two fold; 1. The arterial or excretory pores, which procede from the arteries; by which a certain ſubtil excrementitious humor, exceding in weight all the other evacuations of the human body, is, in an healthful, which is the natural ſtate, continually diſcharged in an inviſible vapor or exhalation, or in a perceptible dewy moiſture. This is the perſpirable or tranſpirable matter, which is diſtinguiſhed into inſenſible or ſenſible Perſpiration or Tranſpiration; the nature and excretion of which was firſt and beſt explaned by SANCTORIUS, an Italian Phyſician, and further illuſtrated by our great LISTER, and the KEILS.

§ 436. 2. The venal or inſorbent Pores, are ſmall and inviſible ducts, which, paſſing, like the arterial, through the ſkin, communicate with the ſmalleſt capillary branches of the venes, and thus convey to the maſs of blood, all matters that are applied to the ſurface of the ſkin in a ſtate ſubtil enough to paſs their orifices.

orifices. By theſe, various medicines are conveyed into the blood and produce their reſpective effects. By theſe, nouriſhment is abſorbed from the very air: For, by theſe alone we can account for the extraordinary fatneſs of cooks, butchers, and other perſons concerned much in dreſſing or handling of proviſions for food: The effluvia or ſubtil exhalations, that conſtantly fly off ſuch bodies, eſpecially when warmed or heated, enter into theſe pores, and are by them conducted to the venes, and ſo mixed with the blood, and by the circulation, applied to the ſeveral purpoſes of the oeconomy. Hence, we may ſee, that good air is neceſſary to our well being; as well for what we may inſpire or inſorbe by theſe pores, as for what we take in by the Lungs. And hence, we may learn how cautious we ſhould be in the choice of water for external, as well as internal application: For both purpoſes, the lighteſt, ſubtileſt, and ſofteſt water ſhould in general be choſen; except in ſome particular caſes, where that, naturally or arteficially medicated, may be found more effectual and proper.

§ 437. This ſhort ſketch of phyſiology premiſed, the effect and operation of topical or external applications in general, that of water in particular, may be more rationally explaned and eaſily underſtood.

§ 438. The water uſed for cold, as well as temperate and warm, bathing are to be conſidered as pure or ſimple; as that of rain, ſnow, ſweet or inſipid ſprings, &c. or as compound, ſuch as the mineral, or medicated waters. Here, we ſhall confine our ſelves to ſimple water ſolely, leaving the others to be treated of in the ſequel, under their proper heads.

§ 439. By bathing in general, is meaned the immerſion of the whole or ſome particular limb or part of the body in water; though certain dry applications, ſuch as heated air and vapor, as well as ſalt, ſand, &c. have obtained, as before obſerved, the denomination of Baths, in a phyſical, as well as a chemical, acceptation. Here, we mean, by bathing, the immerſion

of the whole or ſome particular limb or part of the body, in a ſimple watery fluid onely, either cold, temperate, warm or hot, or lying in the vapor of ſuch. And firſt of cold bathing.

§ 440. The action of water, upon the body therein immerged, depends, 1. upon the purity or heterogeneity of the water; 2. upon its levity or gravity; whence its fitneſs or unfitneſs to diſſolve matters, or enter the pores of bodies; and, 3. upon the different degrees of its Coldneſs or Heat.

§ 441. 1. The pureſt, ſimpleſt waters are the lighteſt, the moſt ſoft and capable of diſſolving and waſhing of bodies, the moſt ſubtil and fit to enter the pores of the ſkin, and dilute the blood. Theſe waters are found cold or hot, according to the temperament of the air and earth through which they have paſſed, or in which they are kept. The more heterogene the water, the more heavy and groſs in general it is found, the more hard and unfit to diſſolve bodies or enter into the maſs of humors by the pores. Its coldneſs or heat depends upon the ſame accidents with thoſe of the moſt pure; for, in this reſpect, all waters are but paſſive; ſome being more ſuſceptible of heat and cold than others, for reaſons before obſerved.

§ 442. 2. The lighteſt water is found eight hundred times heavier, than common air. In this proportion, then, is the preſſure upon the body immerſed in water increaſed, by the greater or leſſer weight of water incumbent upon the ſurface of the body: This is ſo much added to the weight and preſſure of the atmoſphere, which is ſuſtained alike in, as out of, water.

§ 443. 3. Water is rarefied by heat and condenſed by cold. Hence, cold water is heavier, than the like volume of hot. The colder the water, the more denſe, the more heavy, the more groſs and unfit to diſſolve bodies, and enter the pores of the ſkin, it will always be found.

§ 444. Hence, the action of cold water, upon the body therein immerged, is eaſily conceived: It muſt act,

act, 1. chiefly by its fluidity, which qualifies it to embrace and compreſs equally all the parts; 2. by its coldneſs, which conſtringes the ſolids, and condenſes the fluids; and, 3. by its gravity, which, by compreſſing the ſurface with an additional weight, repels all the fluids from the circumference to the center.

§ 445. As the dimenſions of all the veſſels, expoſed to the immediate action of the cold bath, muſt neceſſarily be ſo contracted, as to receive or contain but very little blood, during the impulſe; ſo, of neceſſity, the great, internal veſſels muſt be proportionably diſtended and enlarged. As ſoon, as this external impulſe is removed, if the bowels, which perform the vital functions be vigorous, the blood is propelled with new energy throughout the oeconomy, by the increaſed force given the elaſticity of the fibres of the containing ſolids. And thus, circulation and tranſpiration, which were both for a while, in ſome meaſure, obſtructed or retarded, are reſumed and carried on with more than ordinary vigor. The body, which, before bathing, was cold and chilly, from a languid circulation and an unequal diſtribution of vital heat and ſpirits, the conſequence of a relaxation of the ſolids, grows warm and lively, perſpires freely; and, if cloſe covered up in bed, will ſweat profuſely; all which ariſe from an extraordinary momentum given the blood, by invigorating and bracing up the tone of the relaxed ſolids.

§ 446. The cures performed by cold bathing are all proofs of the truth of this theory. Whatever diſorders ariſe from a debilitated and relaxed ſtate of the ſolids, which muſt ſooner or later bring on a viſcid, fizy, ſluggiſh diſpoſition of the blood and juices, if taken in time, before the bowels are affected or obſtructions are formed, may be effectually relieved jointly by this action of the water and this re-action of the animal fibres, in cold bathing.

§ 447. As the primary and principal effect of cold bathing is wrought upon the ſolids, whoſe action upon

the fluids is thereby promoted or altered; conſtant care is to be taken not to adminiſter this remedy, where, by length of time and other accidents, ſuch a change is wrought in the juices, as may make it dangerous to compreſs or forcibly to propel them from one part to another: For, when they are groſs and viſcid, or onely in too great abundance, dangerous obſtructions or inflammations may be formed, or an increaſe of ſizineſs and viſcidity induced. Beſides, the ſolids will be weakened by every effort, they make to contract or conſtringe themſelves, when the contained fluid is, from its quality or quantity, incapable of yielding to the external compreſſure of the ſolids wrought upon by the cold water. And, when the fluids are by any means reduced and broken, or rendered thin, acrid or ſharp, by increaſing the force of the circulation, or diſtending ſome of the internal veſſels, by the ſudden influx of blood, in the lungs, brain or other bowels, an haemorhage, an effuſion of blood, or burſting of blood veſſels, of moſt fatal conſequence, may well be occaſioned, by ill-timed cold bathing.

§ 448. A ſimilar reaſon renders univerſal cold bathing perilous and deſtructive, where any bowel is obſtructed, inflamed or debilitated: The contraction of the fibres and the conſequent diminution of the diameters of thoſe veſſels, which are neareſt the ſurface or moſt affected by the cold immerſion, muſt occaſion a greater impulſe and diſtention of the veſſels more remote from its action; theſe then muſt receive a greater influx of blood in proportion to their ſizes and the tones of their fibres. Such of theſe veſſels, as are by any means obſtructed, muſt have that obſtruction increaſed or confirmed by cold bathing, and ſuch, as are any way debilitated, muſt be proportionably diſtreſſed by yielding more to the increaſed influx thus occaſioned. Theſe general conciſe cautions premiſed, let us procede to conſider in what caſes and circumſtances cold bathing may be uſed with deſired ſucceſs.

§ 449.

§ 449. As the general diſuſe of water is to be univerſally regretted; ſo the great, modern neglect of cold bathing is much to be lamented by all the northern inhabitants of the earth more eſpecially; but chiefly by the inhabitants of theſe northern iſlands in particular, whoſe natural diſeaſes may moſtly be prevented or cured by the rational uſe of cold bathing. But, to illuſtrate by ſome examples;——

§ 450. There is not any diſorder, to which we are more ſubject, than thoſe, that take their riſe from obſtructed or inordinate perſpiration. The diſcharges by the pores of the ſkin are not only greater in quantity, but of more importance to the oeconomy of life, than all the other excretions taken together. The more changeable and uncertain the climate, the more irregular muſt the cutaneous diſcharges always prove. Our climate being extremely variable, obſtructed perſpiration, with all its train of evil conſequences, muſt be, as we find it, very common. Hence, what we call catching of cold becomes ſo frequent. Hence, the Murr or ſtuffing of the Head, Rheums, or Catarrhs, Coughs, Aſtma's, &c. are ſo rife amongſt us.

§ 451. I do not point theſe out, as diſorders, which may be cured by cold bathing. I have already obſerved, that when the juices are in any wiſe morbid, when they offend in quantity or quality, or when any particular part is inflamed, obſtructed or weakened, cold bathing is in general to be avoided. But, the juſt now mentioned conſequences of obſtructed perſpiration may well be prevented by the timely uſe of cold bathing; which gives ſuch a ſenſible elaſticity to the Fibres, as keeps the ſkin proof againſt the frequent, ſudden changes of the weather, whether from hot to cold, from dry to moiſt, or the reverſe; and, by preſerving that due tone, ſupports a free and equal circulation, and with that, the due ſecretions, as well as this and other excretions, neceſſary to perfect health.

§ 452. Rachitis, or Rhachitis, the Rachits, or Ricketts, as it is commonly called, is a diſorder, that fo-

regners, ſometime, have looked upon as endemial in Britain, peculiar to our ſoil and climate. But, for this notion, there is no good authority. Some look upon it to be a new diſtemper; for no better reaſon, than its not being expreſly named by the ancients; but, the ſigns and ſymptoms of the diſeaſe ſeem to be given by HIPPOCRATES in ſpeaking of the diſorders of children, where he mentions the bending inward or diſtortion of the ſpine, the preternatural growth of the head, &c. It is beſt treated by the moderns; among which, the moſt eminent are our GLYSSON, SYDENHAM, CHARLTON, and MAYOW. By theſe it is confeſſed, the Rachits ariſe from an unequal diſtribution of the nutricious juices; from the abundance of which, ſome parts of the muſcles, bowels and bones increaſe beyond the natural ſize, to the disfiguration, and diſtortion of the parts, or the diſlocation of the joints; whileſt others, from a defect of the neceſſary ſupplies, emaciate, ſhrivel, and conſume. Though this diſorder be too rife in our country, I ſee no juſt cauſe for pronouncing it endemial. It is not improbable, the humidity of our climates may make it appear more common with us, than in drier countries; but, I doubt, no part of Europe will be found free from it; eſpecially, where ſoftneſs and luxury have broken the natural ſtrength and hardy diſpoſition of parents and their unnatural, but faſhionable, ſubſtitutes, Nurſes. The Rachits were not taken notice of in Britain before the year 1620, or thereabouts, when our GLYSSON obliged the public with his treatiſe on this ſubject. About this time it was, that our Anceſtors began ſenſibly to fall from the primitive ſimplicity of their Diet, Cuſtoms, and Manners. From this period, we may date the riſe, and count the progreſs of this enervating and disfiguring diſtemper. It can not therefore be deemed properly endemial, nor ſolely confined to our ſoil or climate. Our phyſicians having firſt favored the world with a rational and juſt deſcription and method of cure

of

of the diſeaſe, is not ſufficient grounds to charge the diſtemper upon Britain. Happy it were for us, had this been the onely diſtemper, luxury had introduced, and that that fell contagion had not more diſordered and disfigured our minds, than the Rachits have deformed our bodies. But, this is no place for political phyſic.

§ 453. Among the various remedies recommended for the Rachits, cold bathing has been found the chief: It is that, by which this diſorder is moſt effectually prevented, and without which, in mine opinion, it can hardly be perfectly cured: For, the moſt powerful alteratives preſcribed, will be found ineffectual in bracing up the relaxed ſolids to their due tone, without the help of frequent and long continued immerſion in cold water. And the early and frequent uſe of it, will be ſufficient to prevent this deteſtable diſtemper.

§ 454. Sir JOHN FLOYER[a] is of opinion, that the Rickets were not known in England before the original cuſtom of Immerſion was exchanged for ſprinkling in Baptiſm. I ſhall not here enter upon a diſquiſition into the ſoul-ſaving or body-healing nature of immerſion, conſidered as a Sacrament. As a phyſical agent, a ſingle immerſion, ſacramentally or otherwiſe performed, could hardly be ſufficient to prevent or to cure this or any other confirmed diſtemper. But, the changing a very antient civil cuſtom, and an eſtabliſhed religious Ritual, ſo remarkably, as from a general immerſion in cold water, to the ſprinkling of the face ſolely, ſlightly, with that element, ſhews that idle fears were contracted about general immerſion, that men began to drop it in every ſenſe, and therefore had the very form of a Sacrament altered by a Canon, to prevent the dreaded ill effects, even in Baptiſm. It muſt then be owing to a general neglect or diſuſe of cold bathing or waſhing, not ſolely to the

[a] ΨΥΧΡΟΛΟΥΣΙΑ: or Hiſt. of cold bathing.

alteration of the baptiſmal manner of immerſion, that this ſenſible change was obſerved to have aroſe in the conſtitutions of our children about the beginning of the laſt century. It is therefore much to be wiſhed, that the ſalutary regimen may in all reſpects be reſtored. It is to be hoped, that men will inure their children, from their infancy, to cold waſhing and cold bathing, as the moſt powerful preſervative and reſtorative of health and vigour. The advantages of which are recommended by the grave authority of ARISTOTLE[a], who ſays it is not onely neceſſary for the preſervation of health; but alſo makes men hardy and ſtrong, fit for the army.

§ 455. In recent luxations, or ſtrains and bruiſes, the veſſels are ſo weakened by the diſtraction, that they receive too great a flux of humors; whence tumor, pain, &c. enſue. In theſe, there is not a more preſent and effectual remedy, than cold water; which, by its weight and by its cooling, contracting quality, preſſes upon and conſtringes the weakened parts, and prevents the flux of humors uſually attending ſuch injuries; in which, the rational cure conſiſts.

§ 456. In the Rheumatiſm and Gout, when the inflammatory diſpoſition and the morbid ſtate of the humors is corrected, cold bathing is found a moſt ſovereign remedy. I mention theſe together, as two fatal diſtempers, which I look upon to have the greateſt analogy to each other; and which are ſometimes taken, the one, for the other. The Gout is an obſtruction of the ſynovial veſſels, thoſe, that carry and ſecern a ſmooth, ſoft, gelatinous fluid for lubricating the ſeveral articulations or joints of the body, to prevent their heating, eaſe their friction, and facilitate their motion. This is always attended with more or leſs inflammation and pain, and with a ſymptomatic Fever, in proportion to the habit of the body, and the ſenſibility of the joint affected. The parts engaged being membranous and nervous, the pain is for the moſt part extremely exquiſite and ex-

[a] Politic. lib. vii. c. 17.

cruci-

cruciating, and the ſymptoms are extended from the internal to the external parts, with tumor, inflammation and torture. It generally commences in the joints moſt remote from the center of motion, the heart; as in the toes or feet, fingers or hands: And, as the vital powers decline, or the diſorder becomes more inveterate, it makes a greater progreſs towards the center; and by ſeiſing on ſome more noble bowel or vital part, cloſes the tragic ſcene.

§ 457. The cauſe of this diſorder is moſt certainly a too viſcid ſtate of the lymph and other juices, ariſing from indigeſtion, from a too mucilaginous and acid, or aceſcent diet. This is aparent from the ſubjects of the Gout, which are generally men paſſed the meridian of life, thoughtful, inactive and ſedentary; ſuch, as are given up to a luxurious, voluptuous courſe of life; wine, cider, and beer bibers; great eaters, eſpecially of animal and other mucilaginous or gelly-giving food; followers of Venus, or the unfortunate deſcendents of ſuch, who are often attacked earlier in life; in all which, eſpecially during the fit, the blood is found viſcid and ſizy; the urine thick and high colored, with other ſigns of a general viſcidity of the Humors.

§ 458. The moſt rational and effectual methods of preventing and curing the diſtemper are farther proofs of this notion. Such as have none hereditary taint, and are moderate in the uſe of the Non-naturals; eat but ſimple food, chiefly vegetable; drink but milk, or water; lead active lives, without exceſs of Venery; and avoid the extremes of heat and cold in their exerciſes; ſuch men, by keeping up a due fluidity of the juices, by the ſimplicity of their diet, without viſcous and inflaming fermented liquors; and by ſupporting a free circulation, and a due tone of the ſolids, by regular exerciſe; are rarely, if ever, ſeen afflicted with this racking diſtemper, the worſt temporal curſe of opulence and luxury. Thoſe, that are attacked, are ſlowly cured by ſuch a method of living,

ing, as I have deſcribed. In the fit, they are relieved by ſeaſonable blood-letting; by attenuating and reſolving medicines, which are chiefly alcaline or alcaleſcent; adding a ſoftening and diluting diet; by warm bathing and fomenting; in ſhort, by every thing, that breaks the viſcidity of the juices, obtunds or blunts acidity, and reſtores the general maſs of humors to their natural fluid, ſoft and balmy texture, and relaxes the tenſion of the fibres.

§ 459. In perſons, who have the misfortune to inherit or contract this morbid, gouty habit, as ſoon as the ſtronger irritation of the inflamed blood abates, which ſome time kept the ſolids, in the immediately affected parts eſpecially, in a tenſe, criſp ſtate; as the fit declines, the fibres in general are found totally unbraced, quite relaxed; which keeps not onely the patient a long time decrepid, but ſubjects him the ſooner to a new fit; as the relaxation of the fibres greatly contributes to increaſe the preſent, or induce a new viſcidity of the juices. In ſuch like caſes and circumſtances, nothing bids fairer for the reſtoration of ſtrength to the enfeebled parts, and preventing relapſes, than cold bathing, which moſt ſpeedily and effectually braces up the relaxed fibres to their due tone, and reſtores a free and equal circulation of the blood and juices; upon which their neceſſary fluidity, together with the requiſite ſecretions and excretions, depend.

§ 460. The Rheumatiſm ſeems to differ chiefly in its place or ſphere of action from the Gout: Whileſt this principally attacks the joints and their adjoining membranes, that affects the muſcles, membranes, or membranous capſules of the muſcles and tendons, the glands, and even the perioſteum, or membrane, that immediately invelopes or covers the bones; and afflicts with pains exquiſitely acute, but inferior to thoſe of the gout; unleſs when the Perioſteum, or ſome very ſenſible membrane, is engaged. It is ſometimes attended with a fever, which is generally of the ſlow, remittent kind. The pains are not always fixed, or confined

to

to the part firſt attacked; but wander, ſhoot, and fly about, ſometimes with aſtoniſhing ſwiftneſs. The parts affected are often tumified, rarely inflamed outwardly. During the fit, the Patient is ſeiſed with a general languor and imbecility, impatient of being touched, incapable of motion, at leaſt in the limbs affected. This excruciating and enervating diſtemper owes its origine to cauſes ſimilar to thoſe of the gout. In the one, a vitiated ſerous humidity and a flatulency prevail more than in the other. Both require a ſimilar method of prevention and cure. After the fit, the tone of the fibres is generally more relaxed in the Rheumatiſm, than in the Gout; and after due evacuation and preparation, the cold bath produces as happy effects in the one, as in the other. In both, the general relaxation of the fibres is cured, a free circulation is promoted, the natural diſcharges ſupported, and deſired health reſtored and preſerved, by cold bathing.

§ 461. The antients made free with cold bathing, when the morbid ſtate of the juices might ſeem to forbid it: Thus, we find, GALEN uſed it with ſucceſs, not onely in the Ephemera or Day-Fever, ſo called from the fits terminating within the age of the inſect, called the Ephemera, or Day-fly, a natural day; but alſo in Putrid and Hectic Fevers, where there was no Bowel inflamed or obſtructed. I have known Intermittents happily cured by the ſame means. It muſt be confeſſed, it is a violent remedy, and that none, but the young and robuſt can well be ſuppoſed capable of withſtanding the ſhock of a ſudden immerſion in cold water, when the blood is highly heated and rarefied by the febrile motion and the ſolid fibres thereby braced and diſtended. They, that can endure the ſhock, muſt certainly undergo a ſpeedy and extraordinary change: For, the excretions by the Pores, by the urinary Ducts or firſt paſſages muſt in all likelihood be greatly increaſed; any of which may well prove critical; and, in vigorous conſtitutions, ſalutary.

§ 462.

§ 462. However unfit or hazardous cold bathing may appear in feveriſh paroxyſms; it is evident from what has been already ſayed, under the heads of Rheumatiſm and Gout, that after fevers, when the vice of the humors is duly corrected, it muſt effectually reſtore the loſſed tone of the fibres; and by preſerving that tone, prevent all ſorts of fevers, as well as many other diſorders. By this manner of acting of water in fevers, we may conceive how, and for what reaſon, it has for ages been deemed the beſt remedy for that moſt dreadful fever attending the bitings of mad dogs and other enraged animals; which diſtemper is generally moſt fatal, when it is attended with the Hydrophobia or dread of water, by which it is commonly attended. Here, the ſudden and unexpected immerſion in cold water powerfully brings on a ſweat, which is the principal relief in this horrid diſtemper. Where a ſweat is not occaſioned, the cold bath is not found ſo ſerviceable as the warm.

§ 463. If I were to enumerate here, the various diſtempers, in which cold bathing may be uſeful, this would prove rather a courſe of Pathology, than a diſſertation on the uſe of water. Let it ſuffice, that I obſerve in general, that where the preſervation of preſent health depends upon keeping the tone of the fibres and the diſpoſition of the cutaneous pores in due order, or where the reſtoration of loſſed health is to be brought about by recovering the natural tone of the ſolids from a contranatural relaxation of their fibres, or by regulating the diſpoſition of the pores, eſpecially from ſuch a ſtate; cold bathing is the principal, if not the ſole, remedy. For proof of this, let us but conſider the happy effects of this application, known to the moſt rude and ignorant of the human ſpecies.

§ 464. Hiſtorians and Phyſicians are agreed, that in the moſt barbarous ages of theſe northern countries, by which I mean the whole continent of Germany, taking in antient Scythia and the modern governments,

vernments, whether popular or deſpotic, of Sweden, Norway, Denmark, Poland, and Muſcovy, as well as theſe our Iſles; immerſions and waſhings in cold water, from earlieſt infancy to oldeſt age, were the common, conſtant uſage, for a great length of time. The antient Romans went out of their hot, into their cold, baths. Several Indian nations have done and ſtill practiſe the ſame; as do the whole people of Finland, Livonia, and the great, extended empire of Ruſſia; where, after warm bathing, they not onely go into common cold and ſuperficially frozen water, but even roll themſelves in ſnow. The effects by this uſe of cold bathing produced, ſhould ſurely be ſufficient to reſtore and eſtabliſh the uſe of it among us; ſince it is obſervable, that not onely the different nations mentioned, but our brave anceſtors the Britons, were larger and ſtronger, as well as more ſtrait and comely of ſtature, more long-lived, more healthy, more robuſt and vigorous in all reſpects, than we or any other people, who have not come into and do not continue this familiar uſe of cold water, have been found in this or any other age. Many men experience, though too few obſerve, the happy effects of waſhing their limbs and eſpecially their heads in cold water. They are much leſs ſubject to catching cold, to catarrhs or defluxions upon the gums and glands of the mouth and throat; to ſtuffings and runnings of the noſe, and the like. And one effect, of importance enough to demand our utmoſt attention, I apprehend to be owing to the uſe or neglect of waſhing the head in cold water: It is a trite obſervation of the practicioners in chirurgery, in France, and other neighbouring countries, even where the climate is not much hotter than ours, that wounds in the head in general, and often the moſt ſuperficial, are commonly deemed, and found upon experience, mortal; whereas, not onely wounds of the face and hairy ſcalp, but even thoſe of the meninges or membranes, that invelope the brain, yea, even with a loſs of ſubſtance, as well

well as a diviſion or ſeparation of the parts, of the brain itſelf, and that by gun-ſhot wounds, as well as by theſe of cutting weapons, are with us, moſt frequently, happily cured. This, I can not think wholely owing to our colder climate, as the like ſucceſs has attended our chirurgeons in the treatment of our wounded men in different parts of the neighbouring continent. Nor can I attribute it ſolely to the now known and confeſſed ſuperiority of out chirurgeons to thoſe of France and other countries. I muſt therefore rather incline to impute it to this; that the people of the continent of Europe in general, the French in particular, accuſtom themſelves to thick, warm, woollen caps at night, and ſeldom or never bathe or waſh the head in cold water; on the contrary, the later are early taught to look upon the cuſtom, as dangerous and barbarous, and therefore abhor it; whileſt our countrymen wear thin linen or no caps at all at nights, and, as often, as they waſh their faces, waſh or bathe their heads in cold water. In the one then, it may be judged, the veſſels of the head and brain are more relaxed, and receive a greater influx of more heated and rarefied blood, than can be imagined in thoſe, whoſe heads are cooled, and whoſe veſſels are contracted in their diameters, within due bounds, by their cool lying at nights, and frequent affuſion of cold water in the day. This hint, however, I ſubmit to the further enquiry and obſervation of the curious.

§ 465. I ſhall conclude what I have to offer further upon this head, with two practical obſervations of great conſequence, though too little attended to.

§ 466. The one is with regard to obſtructions of the urinary paſſages, called Iſchuria, the ſuppreſſion or unnatural retention of urine. This tormenting diſeaſe ariſes from various different cauſes, which may be better conceived by conſidering the nature of this excrement and the texture of the parts, by which it is ſecerned and excreted.

§ 467.

§ 467. The Urine is a liquid excrement, conſiſting of a conſiderable quantity of ſimple aqueous humidity, charged with ſuch heterogeneous parts, as are hurtful to the animal oeconomy. In this, the blood gets ſhut of ſuperabundant ſaline, oily and terrene parts. It is called Lotium, the waſh or ley; for, ſuch it proves to the blood, when it frees it from ſuch impurities, as it is capable of diſſolving. Hence, the ſigns of the different diſpoſitions of the maſs of humors, upon which health or ſickneſs depend, are collected from the appearance and contents of the urine; which, in a morbid ſtate, is found to contain a redundance of ſalt, of oily or earthy matters, or of one or all of them; when, in the natural, healthful ſtate, it is compoſed of juſt proportions of the three, with water enough to diſſolve them, ſo as to carry them off with moſt eaſe and ſafety to the oeconomy.

§ 468. This excrementitious liquor is by a contrivance of ineffable wiſdom ſeparated in the glands, called the Kidnies, from the maſs of blood, by ſuch ſubtil, fine ſtrainers, as do not admit a ſingle red globule of blood, nor any quantity of the ſerum to paſs their ſlender tubes, when the thickeſt and fouleſt urine gets a free paſſage.

§ 469. The extreme orifices of theſe ſmall tubes open and diſcharge their contents into one common receptacle in each kidney; which, from a funnel-formed head, runs, by ſeveral ſmaller canals, into a fine, ſlender, pliant, cylindrical tube, called, the Ureter, and is continued till it opens into the bladder, one on either ſide, near its neck.

§ 470. The Bladder is a cyſtis or bag of a figure nearly oval, or pair-formed; ſeated in the inferior part of the belly of all ſuch animals, as make urine, with its bottom uppermoſt, and its mouth or orifice downwards, eſpecially in man; in adult perſons, it is ordinarily capable of containing about a pint of liquor. It conſiſts of three different membranes or tunics, to which ſome add a fourth. The firſt or outward mem-

brane is a covering, which it borrows from the membrane, that lines the lower belly, called, the Peritonaeum, which extends commonly no farther than the bottom or ſuperior part of the bladder. Betwixt this and the inner, or as ſome call it, the ſecond or middle coat, a cellular membrane is found, often full of fat, which is what ſome look upon, as the fourth tunic. The ſecond or inner coat conſiſts of muſcular fibres diſperſed in different directions, but chiefly tranſverſe and longitudinal. Under this, is the internal, innermoſt or third coat, whoſe inward ſurface is covered with a ſoft mucous or gellatinous ſubſtance, to ſoften and guard this receptacle from being injured or irritated by the urine. The neck of the bladder is furniſhed with a membranous canal of a cylindrical form, guarded with ſuch a mucous liquor, as the bladder itſelf: This tube, called, the Urethra, is about the thickneſs or diameter of an ordinary gooſe quil, and of different lengths in both ſexes; in which it is in common deſtined to diſcharge the urine, but in the male alſo to ſerve in procreation. The neck of the bladder is alſo provided with a muſcle, called, the Sphincter; whoſe fibres make a band, that embraces and cloſes the orifice; ſo that none urine can paſs, till its conſtriction be by ſome means relaxed.

§ 471. From this ſhort, rough ſketch of the anatomy and uſe of the parts, that ſecern, contain and diſcharge the Urine, together with the notion given of that excrement, it can not be difficult to conceive how obſtructions or ſuppreſſions of urine are cauſed. Theſe may be occaſioned by vices of the humors or of the parts; as when the urine is charged with ſharp ſalts, irritations and inflammations of the parts, attended with ſtrangury or iſchury, are brought on; when it is charged with mucous and terrene parts, tartarous or calculous concretions, the Gravel or Stone, in the kidnies or bladder, are produced; which can eaſily obſtruct the paſſage of the urine through any of the tubes.

tubes. But, theſe are not of the kinds of ſuppreſſion of urine, that may properly be relieved, by the external application of water, eſpecially of cold. They are only ſuch, as ariſe from the vices of the ſolid or containing parts; theſe are chiefly from a too great or hard conſtricture of the fibres, eſpecially of the Sphincter; together with a relaxation of the integuments or a diſtention of the muſcular and other coates of the bladder, beyond the power of performing the contraction of their fibres, neceſſary to overcome the ſtricture of the Sphincter and propel the urine.

§ 472. In theſe caſes, which frequently happen, and eſpecially in the later, the common ſtimulating, diuretic, or urine-forcing medicines, which are but too often injudiciouſly adminiſtered, muſt prove dangerous, injurious and deſtructive, as they are generally found upon experience: Such can but irritate; and irritation is more likely to increaſe, than cure or abate the diſtreſsful malady. In the one, warm bathing, which ſoftens and relaxes the overbraced fibres of the retaining muſcles, or of the tubes or membranes of the kidnies, bladder and urethra, is generally neceſſary, with other helps, which are hardly ever found ſafe without it; whereas this often proves by itſelf a ſufficient and effectual remedy. In the other, cold bathing, which alone beſt reſtores to the fibres and membranes of the over-relaxed or diſtended urinary canals and common receptacle their contractile power, which is alſo helped by the preſſure of the water, and the conſtricture of the fibres of the outward integuments and muſcles of the lower belly, which it occaſions; is the moſt ſpeedy and certain relief. I have often ſeen very old perſons, who are moſt ſubject to this kind of retention of urine, and infants, tortured almoſt to death with diuretic and diluting medicines and ſtoved and ſweated to diſtraction, by the preſcription of ignorant or miſtaken practitioners; when a ſimple, ſingle immerſion in cold water, or even the ſudden expoſing the patient to the cold air, has procured immediate relief

by a copious diſcharge of long retained, and by injudicious treatment, heated, ſharpened and increaſed urine. In theſe caſes, therefore, I recommend, preferable to all other medicines, the expoſing the body ſuddenly to the cold air, giving cold water to drink, and bathing firſt the extremities, and after that, if it ſhould be neceſſary, frequently immerging the whole body in cold water, which generally brings the deſired relief moſt ſpeedily.

§ 473. As immerſion in cold water, by helping the over-diſtended and over-relaxed parts to contract, ſo as to promote the natural diſcharge of urine thus too long retained or ſuppreſſed; ſo it effectually cures that flaccid, relaxed ſtate of the fibres often ſeen in old age and infancy, which cauſes a conſtant or frequent and involuntary emiſſion of urine.

§ 474. I cannot cloſe this obſervation, without cautioning every body againſt the pernicious cuſtom of forcibly retaining and ſuppreſſing their urine, againſt repeted calls of nature; by which a total and obſtinate ſuppreſſion has been often fatally induced. This complaint when induced by long-forced, unſeaſonable retention, often the fruit of miſtaken modeſty, is ſometimes tedious and difficult of cure. It generally yields to the ſame means, that relieve ſuppreſſion from a relaxation.

§ 475. The other and the laſt practical obſervation, which I ſhall offer under this head, relates to the firſt, the greateſt, nobleſt and moſt important worldly taſk, ſet by the almighty Creator to his creatures, Generation or Procreation.—Increaſe and multiply was heaven's firſt command to man. A precept conſtantly enforced by the voice of nature and reaſon; yet, though diligently obſerved, it frequently proves fruitleſs in ſome, from certain imbecilities in either ſex, which may be relieved by the uſe of ſimple water.

§ 476. Men often prove incapable of procreation from a ſoftneſs and too relaxed a ſtate of the fibres. For

For this, they too frequently have recourſe to rich nouriſhing diet and warm and ſtimulating medicines, which at beſt, give but momentary help, and often increaſe the malady. Whereas, a plane and more ſlender diet, due evacuation, cold bathing, and regular exerciſe, would more effectually enable them to perform the procreative functions, and make them the fathers of an healthful and vigorous progeny.

§ 477. Women likewiſe ſuffer on the other hand from a too delicate, ſoft and relaxed ſtate of the fibres, which, by deſtroying the retentive faculty, impedes and prevents conception, or expoſes them to the loſs and peril of frequent abortions. For ſuch conſtitutions, there is not a more ſafe and effectual remedy, than cold bathing. This ſhould be uſed before, and continued for about two or three months after conception; bleeding and other proper preparations premiſed. And by this means alone, many women may be brought to be fruitful mothers, who either never conceived at all, or having conceived, never brought forth a living child.

§ 478. One of the many evil conſequences of a relaxed and debilitated ſtate of the fibres is a diſcharge of mucous matter from the urethra in men, which is heightened, by certain infection, to a degree of virulence, beyond the reach of cold bathing; from the womb or vagina in women, in whom it is called, Fluor Albus, the Whites. In both theſe caſes, when ſimple, not at all complicated with any thing more than what merely ariſes from a relaxation of the parts, cold bathing is found a moſt ſpeedy and effectual remedy.

§ 479. It remanes, that we add ſome directions for the uſe of, and proper preparations for, cold bathing, and point out the fit times, ſeaſons and manner of applying it.

§ 480. They who accuſtom their children, from earlieſt infancy, to frequent immerſion or waſhing in cold water, will have the comfort of ſeeing them

grow up vigorous and healthful; and they, who obſerve in themſelves the great benefits accruing from this ſalutary uſe of cold water, beſides the pleaſure it affords, when thus made familiar, will be induced to continue the uſe and benefit of it to the laſt ſtages of life. Such will be found to eſcape rickets, coughs, rheums, rheumatiſms, and the lamentable train of evils, that attends thoſe, who, by too great tenderneſs and warmth in their youth, are rendered feeble and enervate, decrepid and old, before half their glaſs is run. They, who are thus early inured to the uſe of water, require no previous preparation, no particular regard to ſeaſons. They waſh in hot and cold ſeaſons alike, and reap the pleaſure and emolument. I know a gentleman not far from eighty years of age, who, early in life, launched out in trade, and continues it with great vigor, profit and reputation. For many years, this gentleman has accuſtomed himſelf to a ſingular kind of cold bath: He ſits or ſtands naked, while a ſervant wraps him up in a ſheet dipped in cold water. And continues in this ſome twenty or thirty minutes every morning winter and ſummer; and in return, enjoys the moſt uninterrupted ſtate of health.

§ 481. But, ſuch as have not been early or long accuſtomed to this familiar uſe of water, muſt have recourſe to it with caution.

§ 482. 1. Care muſt be taken, that the bowels be free and ſound; void of obſtruction, inflammation, or exulceration.

§ 483. 2. That there be not too great a fulneſs, in the firſt or ſecond paſſages. In either of which caſes, proper evacuation, by bleeding, vomiting or purging, as the exigency of the caſe, and the circumſtances of the patient, may require, ſhould precede the uſe of cold bathing.

§ 484. 3. The times for bathing are when the ſtomach and inteſtinal channel and the bladder are moſt empty;

empty; as in a morning, ſoon after the natural diſcharges are made.

§ 485. 4. The propereſt ſeaſon for cold bathing in general, I take to be the colder ſeaſons, not the hot, which are too frequently recommended. Its effects depend upon the conſtitution of the patient. It warms the ſanguine and robuſt, and in ſuch, promotes perſpiration. The phlegmatic and weak, it cools, and obſtructs their perſpiration[a]. But, in ſuch very delicate conſtitutions, as cannot bear the ſhock of extreme cold, care is to be taken to attemperate the coldneſs of the water to their particular caſe and conſtitution; or, after beginning in the warmer weather, continue the bathing to, or through the cold ſeaſon, as the nature and neceſſity of the caſe may require.

§ 486. 5. No perſon is to ſtay in the cold water till it benumbs or thoroughly chills him. And, as cold bathing is in general intended as a ſtrengthener, the water by its coldneſs and preſſure bringing on an univerſal contraction of the ſolids; this intention muſt be fruſtrated by tarrying long in the water; for, then it becomes capable of reſolving and relaxing theſe fibres, which it is employed to brace up and ſtrengthen.

§ 487. 6. Cold, as well as hot bathing, is beſt adminiſtered in a diſcumbent poſture, as that in which all parts of the body are leſt in motion, or moſt at reſt: For, then the action of the water is moſt equal and univerſal; always obſerving that the head be not the laſt part immerged.

§ 488. The tender and delicate ſhould be forbidden to move or ſpeak much, whileſt they remane in the water; becauſe moving the organs of breathing or ſpeech, or any of the limbs, whileſt under the additional preſſure of the water, may greatly diſtreſs and injure feeble parts. Thoſe, whoſe limbs or fingers are apt to be contracted, ſtiffened or be-

[a] SANCTORIUS de aere et aquis, Aph. I. Aer frigidus et lavacra frigida corpora robuſta calefaciunt, eaque, auferendo ſuperfluum, reddunt leviora. Debilia refrigerant, eaque, vincendo calorem, ponderoſiora efficiunt.

numbed by the cold bath, ſhould not perſevere in the uſe of it.

§ 489. Then the coldneſs of the water may be occaſionally increaſed at any time by the addition of divers ſalts, which ſerve at the ſame time to increaſe its weight and preſſure.

§ 490. All volatile alcaline ſalts increaſe the cold of water; whereas the fixed alcalies cauſe the contrary effect.

§ 491. The vitriolic ſalts ſlightly increaſe the cold of water, alum a little more, borax, more than alum, common ſalt more than borax, common nitre more than ſalt, and ſalt ammoniac moſt of all.

§ 492. The proportions, the chief of theſe bear to one another, as ſet down by M. Van MUSSCHENBROEK *, ſtand thus;

§ 493. 1. Roch alum powdered, two drachms added to two ounces of water, each of the degrees of heat of 44 by the Thermometer } cauſed no ſenſible change upon mixture, but in about half an hour fell to $43\frac{1}{2}$.

§ 494. 2. Borax dried and powdered, two drachms added to one ounce and half of water, each of 45 deg. of heat } mixed cauſed a ſenſible change by falling to 43.

§ 495. 3. Sea ſalt dried and water of the ſame temperament and in like quantity } fell from 45 to 41 upon mixture.

§ 496. 4. Common nitre or ſalt peter, in like proportion and of the ſame temperament, } ſenſibly changed as the niter diſſolved, till it fell from 45 to 31.

§ 497. 5. Salt ammoniac and water in like proportions and of the ſame temperament } fell from 45 to 27.

§ 498. Thus may cold baths be medicated, their coldneſs, and with that, their weight and preſſure increaſed, and other qualities changed according to the intentions of the judicious phyſician.

* In Addit. Tranſlat. Act. Acad. del Cimento.

§ 497. The

§ 499. The vitriols, which are metals, chiefly iron and copper, diſſolved in the univerſal acid, and verdigriſe, which is copper corroded by a vegetable fermented acid; all increaſe, in ſome degree, the coldneſs of water upon mixture. But, we muſt take care to avoid the common error of imagining, that waters impregnated with theſe or any other ſalts, are always to be found cold in proportion to the degree of ſaturation: For, theſe and all ſuch like ſolutions muſt come to the temperature of the atmoſphere, or veſſel, in which they ſtand. So that, though the cold of water be ſenſibly increaſed upon adding theſe ſalts till they be diſſolved; yet, the coldneſs ſenſibly decreaſes, in proportion to the warmth of the air, as ſoon as the ſolution is completed; after which, the heat or cold of the water will depend upon other accidents, as before obſerved.

§ 500. The judicious will alſo be cautious in the uſe of waters, thus diverſly impregnated; as their effects upon the ſolids and fluids muſt be very different from that of ſimple water.

II. *Of Temperate, Warm and Hot Baths.*

§. 501. The antients, whoſe experience taught them the uſes and virtues of baths in general, were moſt exact in the diviſions and diſtinctions of them, as well as in the manner of uſing them. In a regular well conſtituted bath, there were all the conveniencies for ſoftening and cleanſing the ſkin and its pores, by ſweating; by hot and cold immerſion, waſhing and bathing; by inunction, friction, &c.

§ 502. An antient bath conſiſted of four principal parts, by ſome called the houſes or chambers.

§ 503. 1. The firſt was a kind of ſtove, known to the Greeks by the names of ὑποκαυσον, Hypocauſton, προμαλακτηριον, Promalacterion, to the Latins, by the appellations of Laconicum, and Aſſa*. This

* CELS. & CICER.

was compoſed of three cloſe chambers, of convenient ſizes, contiguous to each other, all brought to different degrees of heat, by means of ſtoves properly placed. In the firſt of theſe, the air was but temperately warmed; in the ſecond, it was rendered tepid, or more warm; and in the third, it was heated.

§ 504. Through theſe ſtoves, or ſome one or more of them, every perſon went into the warm, humid bath, without ſuffering the violent ſhock, that muſt attend going from cold air into warm water, which appears or feels hot, in proportion as the body is before cooled. Here, the change was gradual, inſenſible and agreeable to the whole oeconomy. In theſe ſtoves, the body was by ſlow and almoſt imperceptable degrees warmed; the humours liquified; the pores and ducts rendered free and open; and perſpiration promoted to the wiſhed for point.

§ 505. 2. The ſecond was contiguous to the firſt and compoſed of a chamber of a convenient ſize, in which were three large ciſterns of water of different degrees of heat. The firſt, of a blood warmth, the ſecond, warmer, and the third, as hot as could be borne. This was called, by the Greeks, ἀποδυτήριον, Apodyterion, and περιαλήριον, Periaterion; by the Latins, Tepidarium, and Calidarium; though theſe appellations were by ſome beſtowed on the firſt part of the bath, where the bathers undreſſed. Into one or other of theſe, the patient was conducted from one or other of the ſtoves, as the nature of his caſe and circumſtances directed. For this, the ſtove was juſtly looked upon as a proper, the true preparatory. In this, the hardened, contracted or rigid fibres were ſoftened and relaxed; the humours diluted and molified; obſtructions reſolved, pores and other paſſages opened; pains and rigors aſſuaged; and reſt procured.

§ 506. Care

§ 506. Care was taken, that the ciſterns or baths were large enough, not onely to contain a body in the proper poſture at eaſe, but to admit it to move with freedom: For, though almoſt all motion, eſpecially that of the cheſt and lungs were prohibited, to the tender and weak eſpecially; yet, it was rationally judged expedient, they ſhould not be cramped for room, nor in the quantity of water, on which much depends in many caſes. The public baths were made large enough to take in numbers at once.

§ 507. 3. The third part of the antient complete bath was another chamber conſtructed like the ſecond, contiguous thereto, and furniſhed, like that, with three ciſterns or baths, containing ſeverally, water of different temperatures. The firſt contained water moderately warm, the ſecond, tepid, or ſlightly warm, and the third cold water. This was called, Frigidarium, the cooler, or cold bath.

§ 508. Thus did the antients furniſh themſelves with means to alter their habits of body, by air of different degrees of heat, by water of different degrees of heat, and of cold. They prepared their patient for the degree of warmth in the water, they judged neceſſary for his health, by an appropriate degree of heat in the Hypocauſton or Stove; and as the tranſition from the cold air, to hot water was rendered eaſy, familiar and agreeable, by the different degrees of heat in the ſtoves firſt, and then in the Tepidarium and Calidarium; ſo the ſhock to be dreaded from the admiſſion of cold air upon a body juſt come out of an hot bath, was effectually obviated, by the third part of the bath, the Frigidarium or cooler; where the patient was gradually cooled, in two baths, the one cooler than the other, before he was immerged in the cold bath, which was calculated to brace up the relaxed fibres, to conſtringe the pores to their natural diameters, and to concentrate and retain the native and acquired heat. By which, catching cold and all ſuch like accidents muſt have been happily prevented.

§ 509.

§ 509. 4. Finally, the fourth part of the antient Bath was the dreſſing chamber. This lay contiguous to the ſecond and third. It was a cloſe, convenient room, in which the Bathers were dried and cleanſed, had their ſkins ſcraped and rubbed, with proper ſcrapers, fleſh-bruſhes, and coarſe woollen cloaths, and anointed with fit oils or unguents, to keep the ſkin ſoft and prevent the waſte of ſtrength by exceſſive tranſpiration. After which they dreſſed themſelves in it.

§ 510. Thus, were the antient greeks and romans provided with the moſt ſimple, eaſy, natural, and agreeable method of preſerving preſent and re-eſtabliſhing loſſed health, by the different management and application of that moſt noble, but, with us, deſpiſed and neglected, remedy; common water. And whoever conſiders, beſides the neatneſs and elegancy of keeping the ſkin ſweet and clean, the great neceſſity of keeping up thoſe great and moſt important diſcharges, that muſt conſtantly, in an healthful ſtate, tranſpire by the pores of the ſkin, the ſuppreſſion or obſtruction of which lays a foundation for the worſt diſeaſes incident to man; muſt lament the ſhameful diſuſe of bathing, hot and cold, that prevales in our days.

§ 511. Though the antients were thus wiſely furniſhed with the neceſſary variety of baths under one roof; we are not to ſuſpect, that every patient was obliged to go through a courſe of all the ſtoves and all the baths at once: No; they were calculated for the variety of caſes, conſtitutions, and different ſeaſons of the year, that occur; and the patients, according to their reſpective circumſtances, were directed to uſe the one or the other, as it proved moſt expedient and requiſite. Thus, cold and phlegmatic habits were deſtined to the hot ſtove chiefly; and occaſionally, to the hot bath; dry and hot temperaments, to the tepid ſtove and warm bath; the ſoft and lax fibre to the cold bath, and ſo forth: For, as the ſtoves heated and dried in different degrees, they could

onely

onely be ſerviceable in thoſe caſes, where heating and drying were the curative indications. Thus, they became fit for the cold and phlegmatic habit, in anaſarcous, oedematous and hydropic caſes; whileſt they became improper for the hot and dry temperament, whether in a natural, healthful, or in a morbid ſtate, where moiſtening and ſoftening were the onely indications: For theſe like conſtitutions, the ſecond part of the bath, and likewiſe the third were moſt proper; whileſt they muſt have been totally unfit for cold and moiſt habits. But, the fourth part was more or leſs neceſſary to all, that required any of the others, either for cleanſing, rubbing or anointing the ſkin, or for dreſſing in.

§ 512. The wiſe practitioners among the antients, cautioned all that were to uſe any of theſe baths againſt the raſh and indiſcriminate application of them. They ſtrictly forbad them to all plethoric, groſs or full perſons, before due evacuations. Becauſe, the rarefaction of the redundant juices by heat, dry or moiſt, and the ſudden and violent impulſes made upon them by the cold bath were alike dangerous and deſtructive; till the fulneſs was by proper means abated, and the humors had full ſcope to circulate freely allowed them. They were alſo forbidden to go into the Baths with their ſtomachs or lower inteſtines charged with food or excrements; leaſt crudities might be impelled from the firſt into the ſecond paſſages, and thereby obſtructions or inflammations formed. Perſons with weak or obſtructed bowels were alſo prohibited the uſe of baths; leaſt a flux of humors might be invited or propelled to the debilitated bowel, by the hot or the cold bath. And for the like reaſon, that perſons uſing the cold bath were directed to immerge the head, with or before the reſt of the body; ſo, thoſe, who were to uſe the warm bath, were cautioned not to dip the head in the warm water; for fear of over-heating, relaxing or repleniſhing the brain: For, omitting to immerge the head

head with the body, in the cold bath, or immerging it in the hot, muſt alike ſubject it to an influx of humors, which, in moſt caſes, may prove detrimental, if not deſtructive.

§ 513. As the cold bath may be medicated with various minerals, ſo may the hot be impregnated with an infinite variety of bodies from the mineral and vegetable creations. Thoſe, medicated with minerals, are either natural or arteficial. The natural hot baths are called Thermae, and are either ſimple or medicated. The ſimple are ſuch as conſiſt of pure water, whether meteoric or terreſtrial, heated in its paſſage through the earth. Of this kind, are the Baths of Pfeffer, Schwaldsbadt, Toeplitz or Toepliz, in Germany, Schlangenbaden and Hirſchbergen in Sileſia, and divers others, which equal the pureſt rain water in levity and ſimplicity, and whoſe extraordinary virtues are onely to be aſcribed to the purity of the waters, &c. The medicated natural Baths are ſuch as are charged with ſalts of different kinds, with ſulphur, with earths, with metals, and other minerals. As the waters of Bath and Briſtol, in Somerſetſhire, of Aken or Aix la chapelle, of Borſet, and Chaud-fontaine, in Germany, of the Caroline Baths, in Hungary, and others, of which apart, in their proper places.

§ 514. The arteficial medicated Baths are ſuch, as are charged by art with various ſalts, ſulphur, &c. according to the intention of the preſcriber. Baths, medicated with vegetables, are always arteficial. Of theſe, there may be an extreme variety of different intentions; as emollient or relaxing, tonic or aſtringent, &c. All warm baths may and ſhould be rendered grateful to the patient by the addition of ſome aromatic plant, flower, ſeed, or other vegetable ſubſtance, appropriate to the caſe; though the great ſtreſs is to be layed on the ſimple water alone, to which I ſhall confine what I have further to offer on the uſe of warm water topically applied, in the relief of internal, as well as external diſorders.

§ 515.

§ 515. In order to judge the better of the uſes and efficacy of warm baths in the relief of various diſtempers, incident to mankind, let us firſt conſider the mechanical operation of water upon the animal ſolids and fluids, agreeable to the nature and properties of ſimple water, as before layed down.

§ 516. We have already endeavored to explane the operation of cold water; part of which is to be taken into the eſtimate of the action of warm; to wit, its gravity; though this be decreaſed ſenſibly, volume for volume conſidered, in proportion as the water recedes from cold to hot. The other qualities, in which the effects of warm water are different from thoſe of cold, ariſe by accident from the heat, which produces a contrary effect from cold.

§ 517. It has been already obſerved, that ſolid and fluid bodies are condenſed by cold, and expanded and rarefied by heat. Hence, the animal fibres, which upon immerſion in cold water, are conſtringed and contracted; in warm water, are ſoftened and relaxed. And the animal juices or fluids, which are condenſed and propelled from the circumference towards the center, in cold bathing, are rarefied in proportion to the heat, invited from the center to the circumference, where the veſſels, by being relaxed, have their diameters enlarged, and therefore more readily yield to the influx and rarefaction of the humors. The mean while, the pores are freed from all foulneſs, ſoluble, or capable of dilution in pure water; which the natural diſcharges by theſe ducts are. And, by the rarefaction of the blood and the extraordinary dilatation of the heart and the blood veſſels, the pulſe is raiſed, the circulation becomes more vigorous, the heat conſequently increaſed, the ſurface of the body grows red, and the pores of the ſkin diſcharge their contents, with freedom and eaſe.

§ 518. To this, add the gravity of the water, with the extreme ſubtility or tenuity of its parts, and

it will be eaſy to conceive what effects it muſt produce upon an animal body immerged or bathed therein. The blood, more than ordinary, heated from without, may be ſuppoſed moſt powerfully invited towards the parts moſt heated and relaxed. But then, the preſſure of the water, which is calculated by geometricians to be eight hundered times heavier than air, balances, in ſome meaſure, the rarefying power, and forces the blood back again towards the center, that is, into the great bowels and veſſels, whileſt it dilutes the whole maſs, by the intromiſſion of ſome of its ſubtileſt parts by the inſorbent pores. Hence, the inteſtine motion of the conſtituent parts of the blood is conſiderably increaſed, by which its viſſidity is broken and reſolved; obſtructions in general, from that cauſe, are removed, and the ſecretions and excretions properly promoted.

§ 519. From theſe mechanical and demonſtrable effects of warm water, by its heat expanding the ſolids and rarefying the juices, by its gravity compreſſing the external veſſels, and thereby forcing the blood, in them heated and rarefied, into the heart, lungs, brain and other bowels, or into the larger internal veſſels; the evils produced by too hot, and the general unadviſed or ill-judged uſe of warm baths, are eaſily accounted for, and from them, judicious, practical inferences and cautions may be drawn.

§ 520. There is nothing of greater importance to the patient, for whom warm bathing is found proper, nor in which the honor of the preſcriber of this bathing is more concerned, than the aſcertaining the fit times and ſeaſons, the regulating and preparing the ſtate and temperament of the body, for bathing; the determining the kind of bath, and its temperature preciſely, together with the ſpace of time neceſſary for tarrying in the bath, with due accuracy.

§ 521. Without the ſtricteſt obſervance of theſe cautions, miſchiefs infinite muſt enſue. Thus, we find

find unfit ſubjects, or the beſt prepared, upon going into ill-regulated baths, or tarrying too long in them, attacked with head-aches, even to a frenzy; with anxiety and palpitation of the heart, with faintings and ſwoonings, &c. Theſe complaints, or ſome of them, are always likely to attend ſoft, delicate conſtitutions, with relaxed fibres; eſpecially, if the bath be too hot. Such as are ſanguine and groſs, with the inteſtines and other bowels full, muſt be liable to obſtructions, inflammations, fevers, continual or intermittent, with variety of other diſorders depending upon the particular circumſtances of the health and habit of body, upon the ſeaſons of the year and the nature and temperature of the water. The more compound the water is, eſpecially with aſtringent, ſtyptic or abſorbent matters, ſuch as alum, vitriols or earths, which conſtringe, coſtipate or clogg the pores; the more ſubject will the patients be to fevers. An obſervation, which ſhould make men moſt cautious in the uſe of baths, whoſe waters are loaded with any of theſe mineral matters; as the Caroline baths in Hungary, ours in Somerſetſhire, thoſe of Boſſet near Aken, and the like.

§ 522. Hence, every judicious perſon will with me conclude, that the ſofteſt, lighteſt, pureſt water, as it is the beſt for all the purpoſes of the oeconomy of life; ſo is it alſo preferable to all others for warm baths; except, where the additional force of a ſubtil, mineral ſpirit, of ſubtiliſed ſulphur or its elements, or ſome alcaline or other reſolvent and deterſive ſalt, ſuch as are found in the natural Thermae, or may be occaſionally added in factitious baths, may be judged expedient for particular purpoſes and in extraordinary emergencies: For, whatſoever is found capable of obſtructing the firſt and great intention of warm bathing, ſoftening and relaxing the fibres in general, particularly thoſe of the ſkin and its pores, which are cleanſed and opened thereby, and prepared

to

to yield their contents by ſweat and tranſpiration; whatever, I ſay, is found repugnant to theſe intentions, renders warm bathing of none effect, if not perilous. This is eaſily conceived, upon conſidering ſome of the infinite variety of evils, that neceſſarily attend the obſtructing the pores at any time and in any manner; eſpecially, at ſuch times, as the blood is greatly heated. Thus, the common diaphoretic or ſweating medicines prove injurious and often deſtructive, by their heating the blood, when the pores are not diſpoſed to open and yield their contents. Hot or warm bathing muſt heat and rarefy the juices, as well as expand the ſolids. The pores muſt at this time be greatly diſtended or relaxed; and conſequently, if the water be charged with aſtringent, drying, terrene bodies, the pores may be ſo clogged and obſtructed therewith, as to counteract the warming and ſoftening quality of the bath, and thereby prove of extreme evil conſequences.

§ 523. Though bathing may, at firſt ſight, be looked upon, as in ſtrictneſs it is, a topical application; yet, as no topical medicine can be ſo circumſcribed in its operation, as to affect the outward parts, to which it is immediately applied, onely; ſo none outward application more ſenſibly affects the internal parts, even the univerſal frame, than warm bathing. And when we come to conſider the vaſt variety of internal, as well as external maladies, for which this moſt ſimple, yet powerful application, has been found an approved remedy, from the earlieſt ages of the healing art; we ſhall find, that all our modern boaſted improvements in anatomy and phyſiology, and in the mechanical accounting for the operations of medicines, will appear in judgment againſt us, and reproach us for our ſhameful neglect of one of the moſt effectual remedies, with which bountiful nature or human art has furniſhed indigent mortals.

§ 524. The

§ 524. The general eſtimation and uſes of warm water, among the antients, may be conceived from the authority of the GREAT FATHER of the medical art; who in his aphoriſms tells us, that warm water ſoftens the ſkin, attenuates the humors, aſſuages pain, mitigates rigors or contractions, convulſions and diſtenſions of the nerves, or contractions of the tendons, and cures diſorders of the head [a].

§ 525. This grave authority is followed by that of ARISTOTEL, VITRUVIUS, PLINIUS, CARDANUS, GALEN, ARETAEUS, TRALLIANUS, CELSUS, PLATERUS, PR. ALPINUS and many others, to which the great HOFFMAN [b] adds no ſmall weight. Beſides, every man of ſenſe and judgment approves it; yet, to our hardly delible reproach, the jokes of the ignorant vulgar, who deſpiſe every thing common or known, and who are to be fed upon ſecrets and myſteries; or the idle ſneers of an humorous ſatyriſt, are enough to exclude it the book of modes, and of courſe, to caſt it totally out of practice.

§ 526. Let it be mine ungrateful taſk to ſtem this torrent, and ſtrive to oppoſe ſuch of the potent living practicioners, as have run into this ſhameful neglect of the beſt of remedies, with common reaſon, not the farcical faſhion, that has long diſfigured the fair face of phyſic. In this unequal conteſt, I ſhall be allowed to take to my ſeconds ſome of thoſe illuſtrious dead, whoſe works have made them immortal, however their precepts and example, in this inſtance, come to be neglected in our days.

§ 527. From the mollifying and relaxing power of warm water, mentioned in the late cited aphoriſm, together with its quality of diluting, attenuating, and rarefying the juices; its extraordinary efficacy in aſſuaging the pains of inflammations, in reſolving and

[a] Calidum, ſeu Therma, cutim emollit, attenuat, dolores tollit, rigores, convulſiones, nervorum diſtentiones mitigat, capitis gravitatem ſolvit, &c. HIPPOCRAT. ſect. v. aphor. 22.

[b] De balneor. aquæ dulcis uſu in affect. internis.

relieving diſtentions, contractions, ſpaſms and convulſions, in warming and invigorating cold, emaciated and paralytic limbs, is derived.

§ 528. Many and innumerable are the ſervices, that warm water, outwardly applied, may effect in various diſorders and diſtreſſes of the human body.

§ 529. In hard and difficult child-bearing labors, where from the extraordinary ſize of the infant or the inordinate conſtriction or rigidity of the parts, when men have recourſe to the moſt violent meaſures, ſuch as threaten the deſtruction of both infant and mother; warm bathing might ſo ſoften and relax the fibres, as to bring the moſt ſpeedy relief to both. Had due regard been payed to this moſt ſafe and rational practice, there would be leſs occaſion for horrible inſtruments, or the herculean ſtrength, now aſſerted to be neceſſary, and there would be fewer dreadful diſaſters, than we daily ſee or hear of, in the modern maſculine practice of midwifery.

§ 530. The like eaſy ſuccor might be afforded in the ſuppreſſion of urine, or in that of the menſtrual or habitual hemorhoidal diſcharges, when ſuch ariſe from an undue tention or conſtriction of the parts, or a viſcidity of the juices. Warm bathing ſo ſoftens and relaxes the fibres, as to inlarge the diameters of the veſſels; and while it dilutes and attenuates the juices, by its preſſure upon the external parts, it promotes the propulſion of noxious matters by the proper emunctories. For all theſe like caſes, univerſal bathing is not neceſſary; the half bath, otherwiſe called, Encathiſma, Inſeſſio and Semicupium, is ſufficient; in which the patient ſits up to the navel or region of the ſtomach in warm water, the ſuperior parts being kept dry and covered.

§ 531. There is another kind of partial bathing celebrated for its great efficacy in the relief of heavy and acute pains of the head, inflammations of the eyes, dry and convulſive coughs and aſthmas, hypochondriac and hyſteric melancholy, palpitation of the heart,

cholic,

cholic, &c. by the beſt practicioners, antient and modern. I mean the Pediluvium or Lavipedium, the bathing the feet in warm water; by which the pores of theſe extremities are opened, the fibres ſoftened and relaxed, the diameters of the veſſels inlarged, and a flux of humors invited or derived to theſe extremities, to the relief of the more noble parts oppreſſed. Yet, this admirable method of practice, which has its foundation in true phyſical reaſoning, and is confirmed by the experience of ages, is now more frequently abuſed by old women and nurſes, than recommended by regular phyſicians!

§ 532. But, the greateſt efficacy of warm bathing is found in violent conſtriction or coſtipation of the pores of the ſkin or the excretory ducts and paſſages, attended with contractions, diſtentions, ſpaſms and convulſions, with extreme pain.

§ 533. In theſe caſes, warm water brings the ſpeedieſt relief, and that for the following among many obvious reaſons;

§ 534. The ſkin, as has been before obſerved, is the common integument or covering of the whole body. It may be looked upon, as the common emunctory: For, we can conceive no webb, that has more perforations or pores, than the human ſkin. Through theſe, there is a conſtant uninterrupted diſcharge, which ſurpaſſes in quantity all the other diſcharges of the body, and on the regular performance of which the health of men does eſpecially depend. This diſcharge, in the moſt healthful ſtate, is of a greaſy, clammy nature; liable, if not frequently rubbed or waſhed off, to cauſe itchings, eruptions, excoriations, to ſtench and putrefaction, and to clogging and obſtructing the excretory ducts or pores; which are as ſo many common ſewers to a city, to carry off redundant humors, which retained, muſt turn to putrid filth and naſtineſs.

§ 535. The worſt diſorders, incident to man, derive their origine from the later cauſe; to wit, obſtructed perſpiration. Our firſt care then ſhould be

to preſerve this diſcharge in due regularity, or to reſtore it, when by any means ſuppreſſed.

§ 536. This, in many caſes, is moſt effectually done by the rational uſe of warm bathing; by which the diſcharge is kept up, the ſuppreſſion removed or obviated, and thereby the train of evils attending the ſuppreſſion, cured or prevented.

§ 537. The operation of warm water, in this and the like caſes, may be accounted for, from what has been already ſayed, particularly in treating of the nature and properties of water: It muſt diſſolve and waſh away the perſpirable matter, and thereby remove the obſtructions of the pores; it muſt ſoften and relax the fibres, dilute and thin the fluids, promote a free and regular circulation of the blood, increaſe its motion, and promote the ſecretions and excretions, in which the cure of theſe diſorders conſiſts.

§ 538. As there is nothing more conducive to the health of man, than the keeping up this diſcharge, whoſe retention is found ſo noxious; the great and remarkable efficacy of warm bathing in promoting it, and thereby preſerving or bringing about the moſt ſalutary depuration of the juices, will appear from conſidering the effects it produces in ſundry diſtempers ariſing from a morbid ſtate of the juices and the ſuppreſſion of the cutaneous diſcharges.

§ 539. Many chronic and moſt acute diſeaſes are brought on or aggravated by obſtructed perſpiration: Nor can any of them be effectually cured, without reſtoring this moſt neceſſary diſcharge.

§ 540. In moſt Fevers, the antients had recourſe to warm bathing. But moſt eſpecially in the intermittent, in which they preſcribed them, eſpecially in the intervals, and upon the decline of the paroxyſm. The reaſon for this ſalutary practice, which is authoriſed by HIPPOCRATES, GALEN, and CELSUS, may well be collected from what has been before ſayed; as the juices are found viſcid and ſizy, the circulation languid, and the perſpiration ſuppreſſed or obſtructed.

§ 541.

§ 541. In burning and continual fevers, warm bathing was recommended, once and in the beginning of the acceſs, by ſome of the beſt practicioners among the ancient Greeks [a].

§ 542. The Egyptians uſed the like practice: For, we are told, that the uſe of warm bathing was common and familiar to that people in all fevers, whether ardent, putrid, continual or intermittent; with exception to the peſtilential onely; but, not ſo much upon the commencement, as towards the decline of the fevers [b].

§ 543. TRALLIAN greatly recommends warm bathing in tertian fevers; eſpecially in hot and dry habits of body, and before the concoction of the morbid humours is performed [c].

§ 544. GALEN recommends it alſo in the like caſes and upon the ſame conditions; and ſays, that it cannot annoy, if it be adminiſtered twice a day.

§ 545. CELSUS is of the ſame opinion; but recommends the bathing, the firſt day, the fever intermits [d].

§ 546. HOFFMAN confirms this method of practice; eſpecially, after clearing the firſt paſſages by aperitive, ſaline medicines; wiſely and juſtly judging, that the morbific, febrile matter can not ſo effectually be diſcharged by any other emunctory as by the pores of the ſkin [e].

§ 547. PLATERUS uſed warm bathing with ſucceſs in quartan fevers, on the days immediately preceding the fit [f].

§ 548. But, the Father of phyſic inculcates this ſage caution, that bathing be not performed in the acceſs, or during the paroxyſm [g].

§ 549. The uſe and reaſon of a practice, thus ſupported by the beſt authorities, muſt be evident to

[a] GALEN, l. viii. cap. 3. Meth. medend. [b] PR. ALPIN. de Medic. Ægypt. [c] Lib. xii. p. 735. [d] Lib. ii. c. 17. [e] Tract laſt cited. [f] Lib. ii. Obſ. p. 281. [g] HIPPOC. de morb. mulier.

every man endued with common ſenſe and a competent judgment in phyſic; yet, we unfortunately find it almoſt quite exploded.

§ 550. But, theſe kinds of acute diſeaſes are not the onely maladies, whoſe malignity is beſt carried off by the pores of the ſkin: For, warm bathing is ſtill found moſt univerſally effectual in the relief of chronic diſtempers.

§ 551. Before we come to give inſtances of theſe, I ſhall mention one kind of acute diſeaſe, for which bathing is found the moſt effectual remedy. I mean that moſt dreadful of all fevers, which attends the bite of mad dogs and other inraged animals, and is attended at the ſame time with an inſatiable thirſt and ſuch a dread of water and other liquors, as occaſions horrors and convulſions at the bare ſight of any of them. This ſtage of this moſt horrible and ſhocking diſorder is called, the Hydrophobia, or dread of water. And for the cure of it, ſudden and unexpected immerſion, and long detenſion, in cold water has been recommended from earlieſt antiquity as the ſole remedy [a]. After which, the patient was to be rubbed with, or immerged in, warm oil, and then diſpoſed to ſweat, by covering up cloſe in warm bed and giving rich wines and other cordials, in which the cure conſiſted.

§ 552. But, though cold water might well produce this effect; yet, it certainly was more likely to be ſpeedily and completely performed by warm water. And accordingly we are informed by CELSUS, that a perſon, bit by a mad dog, was immediately carried to a bath, where he was bathed and ſweated, as long as his ſtrength would admit; leaving the wound open, for the freer diſcharge of the malignant matter. Then, as the moſt ſovereign antidote for all poiſons, they gave him plenty of rich, generous wine. And having continued this courſe for three days, they

[a] CELS. Lib. v. c, xxv. SENNERTUS, HILDANUS, and all the practical writers. Alſo § 460.

judged

judged the patient cured. But, what ſeems to countenance the warm, in preference to the cold, bath, we have from the ſame authority: For, CELSUS in the ſame book and chapter tells us, that if any diſtreſs to a delicate body was apprehended from the cold bath, which ſometimes brought on diſtentions of the nerves or convulſions, and the death of the patient; to prevent this, he was to be immediately after the cold, bathed in warm oil. Which ſhews that warm bathing is more ſafe and effectual than cold.

§ 553. In confirmation of this practice, HOFFMAN [a] cites a caſe, communicated by a certain German phyſician, to this effect: A mad wolfe ran out of a foreſt and bit great numbers of unfortunate men in the neighbourhood. Many of theſe men died before any remedy could be found. At length, an illiterate boor hit upon an effectual cure. He gave each bitten perſon a doſe of Venice treacle and the ſpongy fungus of the dog-roſe, or briar, which is the neſt of a certain inſect, and afterwards put them into a moderately warm bath. He continued them there a conſiderable time, in order to prepare them to ſweat plentifully, and repeted this proceſs for ſeveral days ſucceſſively, which was at length attended with the deſired ſucceſs. By which we ſee, the cure of this virulent fever, as well as that of others, was effected by ſoftening and relaxing the ſolids, cleanſing the pores, diluting and attenuating the juices, inviting them from the center to the circumference, and cauſing the malignity to be thrown off by ſweat.

§ 554. When we conſider the immenſe quantity of ſordid and offenſive matter, that is caſt off by the pores of the ſkin in bathing, we ſhall ceaſe to wonder at the variety of diſtempers, as well chronic as acute, which are remedied by warm bathing.

§ 555. There is hardly any human ſkin ſo clean, as not to foul a large quantity of warm water, upon

[a] Tract laſt cited.

bathing in it. And a bath, once uſed by the cleaneſt perſon, is very apt to corrupt and putrify. In baths, uſed by ſome perſons, a groſs fat ſubſtance has been found afloat, in ſuch quantities, as to be capable of being collected like fat upon broth. Of this kind, ſome remarkable hiſtories are given in the Miſcelanea Naturae curioſa. I ſhall here onely recite two [a]. The one, of a woman, who after having tried all other remedies in vane for a pain in her loins, at length had recourſe to warm bathing, by which ſhe was happily relieved. And a groſs fatty ſubſtance was always found floating on the bath. The other, of an hypochondriac perſon, who upon bathing made the water ſmell moſt offenſively, and left a groſs, thick, black ſcum afloat on it. Theſe daily increaſed with ſuch a degree of acrimony as bliſtered the bather or attendant's hands; till at length, the diſcharge ceaſing, the patient was relieved from his complaints. And the celebrated VOLCKAMERUS tells us of a woman, whom he cured by the ſame means; who diſcharged a conſiderable quantity of this kind of filth every day in the bath [b].

§ 556. It is certain, none other known medicine could ſo effectually bring away this noxious filth, through the pores of the ſkin, as warm water; wherefore, in all caſes, where a diſcharge of that kind is to be promoted, warm bathing muſt prove the moſt ſafe and effectual remedy.

§ 557. Gouty and rheumatick paroxyſms are the moſt painful and diſtreſsful, when the patient or parts affected do not ſenſibly perſpire; and the diſtreſſes are always mitigated by gentle ſweating. Nothing ſooner takes off the tention and criſpature of the fibres and aſſuages the attendant pain; nothing cleanſes and opens the pores and diſpoſes the patient to a mild and gentle ſweat, ſo effectually, as warm bathing. Conſequently,

[a] Decad. II. Ann. vi. Obſ. 239.

[b] HOFFMAN, Tract laſt cited.

it

it well deſerves the attention of phyſicians in theſe intentions.

§ 558. Scorbutic complaints of moſt kinds are aggravated, if not induced, by obſtructed perſpiration. The rational cure of every ſtage of this diſorder, eſpecially that attended with acute pains in the limbs, conſiſts in diſpoſing the humors for diſcharging the morbid matter by the pores of the ſkin. This is done by dilution with ſimple water, warm bathing, and the uſe of acids and other diaphoretics.

§ 559. The laſt ſtage of the venereal evil, that moſt foul, noiſom and excruciating diſtemper, in warm climates, where tranſpiration is moſt free, is much leſs noxious and diſtreſsful, than in theſe northern regions. In Italy and other countries, where they have plenty of natural baths and ſtoves, many men keep this diſtemper moderate during their whole lives, by a courſe of warm bathing and ſweating, performed once or twice a year. And it is certain, that with us, it is never ſo well cured, as by thoſe practicioners, who determine the morbid diſcharges moſt by the pores of the ſkin, by the means of warm baths and ſtoves. Nor, do I believe it can ever be certainly cured, but by theſe means, and upon theſe principles. How many wretches do we daily ſee harraſſed to diſtraction and almoſt to death, often reduced to the worſt hectic ſtate, by long, teadious and violent ſalivations; yet, after a few days reſpite, again tortured with the ſame pains and other direful ſymptoms, for which they were forced to undergo this moſt ſevere and unnatural regimen? Some of theſe unhappy ſufferers, we ſee eſcaping from ſome ſordid cell, contentedly hugging himſelf upon the happineſs of his cure; when, in leſs than a month, all his former complaints rage with more than double fury. If ſuch fall into the hands of the injudicious, they are again put into an other mercurial courſe, in which they rarely meet with better ſucceſs; except, in having an end put to all worldly evils by death. How are they then to be

cured,

cured, before matters are brought to this laſt extremity? By bathing and ſweating onely; without which, the body can never be effectually prepared for a mercurial courſe of any kind; nor can that courſe be duly completed without cloſing it by frequent bathings and ſweatings, which are ſometimes properly and neceſſarily interpoſed during the courſe. Thus, we ſee patients, which after one, two and more ſalivations and divers drenches with mercury in various other ſhapes, in order to vomit, purge or ſweat, to little or no good effect; upon falling into the hands of the judicious, cured by warm bathing, gentle ſweating, and the uſe of a few ſweetning, which are all diaphoretic, medicines. Hence, it appears, that warm bathing and ſweating is in itſelf a palliative, if not a radical cure for the pox; that it is the beſt preparative for a mercurial or other diaphoretic courſe, and that when ſuch a courſe has been puſhed to the utmoſt extremity; ſome of the old leaven of this foul diſeaſe generally remanes in the maſs of humors, which can beſt be expelled, by the pores of the ſkin, duly diſpoſed for ſweating, and cleanſed by a proper warm bath.

§ 560. There are no chronic diſorders more rife among us, and which, after a certain ſtanding, are more rarely relieved by medicine, than Hyſteric, Hypochondriac and Maniac affections. Yet theſe, I apprehend, may be greatly helped, if not often happily cured, by the judicious application of water internally, as well as externally.

§ 561. The ſufferers under theſe melancholy diſeaſes are more or leſs ſubject to indigeſtions, obſtructions of the natural diſcharges; not onely by the pores of the ſkin, but by the other emunctories; as well as to ſuppreſſion of the menſtrual or habitual hemorhoidal fluxes; to an unnatural conſtriction or coſtipation of the bowels, of the inteſtinal channel in particular; with an interruption of their vermicular motion, with ſpaſmodic contractions and convulſions, and in time

time with obſtructions of the liver, ſpleen, pancreas and meſſenteric glands.

§ 562. From the irritation, compreſſion, conſtriction and other diſtreſſes, theſe membranous and nervous parts, of moſt exquiſite ſenſibility, muſt ſuffer in theſe circumſtances, the whole nervous ſyſtem muſt ſooner or later be affected; every juice muſt degenerate, every function be interrupted, if not obſtructed.

§ 563. If theſe diſtempers commence from thoſe diſorders in the firſt paſſages and other lower bowels, our firſt care ſhould be to reſtore matters to rights in theſe parts. And it is clear, that nothing can be thought or found ſo effectual in mollifying and relaxing the indurated and criſped fibres, in reſolving the unnatural conſtriction, coſtipation, obſtruction and compreſſion of the inteſtinal bowels and glands, and in aſſuaging pains, ſpaſms and convulſions in theſe parts, as warm water internally taken and externally applied in baths or ſemicupia. By theſe, a freer and more equal circulation, with all its conſequences, are happily reſtored; and the brain, which was oppreſſed by the influx of the whole crude maſs, is relieved by the invitation or derivation of the humors towards the belly and lower extremities; whoſe veſſels, in the diſordered ſtate, were incapable of receiving a due proportion of the blood, eſpecially thoſe of the limbs, whoſe veſſels are commonly conſtringed, in theſe caſes, by an unnatural coldneſs.

§ 564. In theſe circumſtances, we frequently ſee the moſt violent pains of the head relieved by a pediluvium or bathing of the lower extremities in warm water. And in the fair ſex, when uterine obſtructions bring on, with pains in the part firſt affected and contiguous bowels, convulſions and even epilepſies; they are often cured by the judicious uſe of warm bathing alone, and can ſeldom or never be cured without it: For, if this be not premiſed, moſt hyſteric and deobſtruent medicines may not onely frequently fail in their effects, but often prove dangerous and de-

deſtructive. But, after the fibres of all the ſolids and the juices are, as before explaned, altered by warm bathing; after the lower bowels are relieved from their conſtriction and compreſſion, by this means; not onely in hyſteric, but in hypochondriac affections; then, not onely all the appropriate officinal remedies are given with the utmoſt ſafety and deſired ſucceſs, but the mineral waters, particularly the chalybeate, exert their power and efficacy moſt remarkably, moſt happily.

§ 565. Warm bathing, for the like reaſons, had long been an eſtabliſhed and approved remedy amongſt the antients, in all kinds of Mania or madneſs; though in this, as well as other reſpects, it has become ſo much neglected by the moderns.

§ 566. TRALLIANUS recommends long and frequent warm bathing, eſpecially during the ſummer ſeaſon, in melancholy madneſs [a].

§ 567. ARETAEUS adviſes warm bathing in the ſame complaints, and upon the like principles, with thoſe we have layed down [b].

§ 568. Of the ſame opinions are CAELIUS AURELIANUS [c] and PROSPER ALPINUS [d]. The former of which recommends the natural nitrous baths, thoſe eſpecially, that are inodorous and inoffenſive to the brain; the later recommends univerſal bathing, but particularly, the pumping warm water upon the coronal ſuture; by which, he ſays, many were happily cured; yet, it is a practice, not quite agreeable to

[a] Dulcium balneorum uſus, ſi quid aliud, melancholicis opitulantur: Et paulo poſt——Ægri in balneo morentur diutius, ac in calidum deſcendere cogantur, omnino etiam, ſi aeſtas fuerit, in eo diutius defideant. Lib. i. p. 107.

[b] Melancholicos in aquis ſponte calidis ſaepe commorari, neceſſe eſt; rarae enim & molles ad aegritudinis remiſſionem maxime faciunt, verum ſiccae & tenſae, melancholia laborantibus, carnes ſunt. Lib. vii. m. 134.

[c] Morb. chron. Lib. i. p. 335. [d] De Medic. Ægypt. p. 115.

the

the principles, upon which warm bathing is in general recommended, in diſorders of this claſs.

§ 569. The diſorderly, conſtringed and obſtructed ſtate of the bowels of the lower belly, which cauſe or aggravate hyſteric, hypochondriac or melancholy affections, are not the onely complaints, in theſe parts, for which warm bathing proves a ſovereign remedy: For, it is not leſs effectual in all violent griping pains, convulſive and nephritic cholics, and all ſuch diſorders as ariſe from a dry, tenſe or coſtipated ſtate, where there is no violent inflammation attended with a plethora or fullneſs; in which caſe, veneſection ſhould be premiſed to warm bathing. By this means, the eaſy propulſion not onely of hard or indigeſted matters, of long-retained and indurated excrements in the inteſtinal channel is promoted, but the diſcharge of ſabulous or calculous concretions in the ureters or urethra is happily facilitated, by the ſoftening, relaxing and dilating the paſſages. The operations of the bath in all theſe like caſes are aſſiſted by the internal uſe of warm water in ſoftening apozemes and brothes, or mixed with oils and ſome gentle ſtimulating, neuter ſalts, or ſoap.

§ 570. This method, in this ſort of nephritic diſorders, is not onely countenanced by the beſt writers and practicioners amongſt the moderns, but has been early in uſe among the antients; as TRALLIANUS [a] and ARETAEUS [b] teſtify; particularly the later, who recommends, in ſuch caſes, the ſemicupium, which almoſt inſtantly eaſes the excruciating pains attending the obſtructions of ſtone or gravel in the tender, membranous paſſages; provided the water be not too hot, and the patient too full and ſanguine; in which caſes, it may be hurtful, without due evacuations, and other neceſſary precautions.

§ 571. Thus, we ſee what a vaſt number of diſtempers, external and internal, acute and chronic, may be relieved by the methodical uſe of water in warm, as well as cold baths. To which may be added

[a] P. 543 & ſeq. [b] P. 18.

this

this uſeful remark, that by warm water properly applied, the operations of many of the moſt potent, herculean medicines are at the ſame time mitigated and rendered more efficacious. Thus, for example, all the powerful ſudorifics exert their force with more mildneſs and efficacy, upon having the humors thinned and rarefied, and the ſolids ſoftened and relaxed, than they could otherwiſe do; without this preparation, they may heat and diſtreſs, but may fail of promoting ſweat; whereas, after it, they can neither offend nor fail in the effect.

§ 572. The antients, with great wiſdom and judgment, premiſed warm bathing to the uſe of their hellebores and other draſtic purges and vomits; by which they not onely obviated the pains and ſpaſms, which might otherwiſe attend the uſe of theſe harſh and rough-operating medicines, but more effectually prepared the ſolids and fluids to throw off peccant and morbid matters, with the greateſt eaſe and ſafety. All courſes of mercury, whether for promoting ſweat or ſalivation are rendered much more ſafe and effectual by warm bathing. Nor can ſuch a courſe be with propriety inſtituted or finiſhed, in any caſe, without frequent bathing before and after it: For, by premiſing bathing, the ſolids and fluids are moſt effectually diſpoſed to receive the impulſes of this moſt active, powerful remedy, and to diſcharge the morbific matter, of whatſoever nature it be, by the common emunctory, the ſkin; by which, the violent and often dangerous influx of ſaliva upon the glands of the mouth and throat, is moderated or obviated, at the diſcretion of the judicious preſcriber.

§ 573. The evil effects, that attend chalybeates in female obſtructions and hypochondriac caſes, and thoſe of Peruvian bark, in intermittent diſorders, where they ſometimes cauſe a moſt violent conſtriction or coſtipation of the bowels, with ſuppreſſions of other natural and neceſſary diſcharges, may be prevented

vented or relieved by the prudent adminiſtration of warm bathing.

§ 574. It is now fit we ſhould cloſe this head with ſome neceſſary directions and cautions concerning the uſe of baths.

§ 575. 1. The proper ſeaſons for courſes of bathing are the warm months of the year, thoſe very months, when the modern practicioners ſend away their opulent, as well as other, patients from the baths, and make room for the neglected beggars to meet with cures, which this ill-judged practice denies to the rich. But, of this, more in its proper place. Here let it ſuffice to ſay, that as cold weather is the beſt ſeaſon for cold bathing; ſo is warm weather the beſt ſeaſon for warm bathing. For, ſimple warm baths, ſince the time of GALEN[a], were looked upon as humecting and cooling. Though, notwithſtanding, either may with due care and caution be applied in any ſeaſon, known in our temperate climate. It is certain, that cold bathing does moſt ſervice to thoſe whom it warms, and warm bathing is moſt effectual, where it cools, rather than heats. Both are deſireable then, at different ſeaſons of the year. And, as the patient, who uſes the cold bath in winter, is thereby defended from the inclemency of the weather and prevented catching cold; and he, who uſes the warm bath in the ſummer, is apt to find the warm air, which he, before bathing, judged ſultry and intolerable, temperate and grateful, if not cool after it, and is however leſs liable to catching cold in that temperature of the air, than in any other; it is evident, the ſeaſons for cold and warm bathing are quite miſtaken among us, and that we ſhould have recourſe to our cold baths in winter, and to our warm baths in ſummer[b].

§ 576.

[a] Lib. i. Artis curativae ad Glauconem; p. 457.

[b] This is further countenanced, againſt the modern practice, by the great SANCTORIUS; in his invaluable tract, Medicina Statica, § II. Aphoriſm. I. before cited, § 483. 4. as well as in Aph. II. which

§ 576. 2. The time of the day generally recommended for warm, as well as cold bathing, is in the morning early, ſleep and digeſtion being well performed, and the urinary and alvine excrements diſcharged. This may be a proper time in the former, for ſuch patients, as are able and fit to go into the cold bath, and thence into the open air, after warm bathing. But, as the generality juſtly adviſe the patients, after warm bathing, to go into a warm bed, either to ſweat or cool gradually or both; I ſee none objection to the bathing at night, upon an empty ſtomach and bowels, when one may go into bed for the whole night, and ſweat, ſleep and cool at leiſure, ſo as to be in no danger from going, with due caution, into the open air the next day; which can not commonly be done with ſafety on the days, upon which one bathes in the morning. Beſides, wearied travellers can not be denied the comfortable refreſhment of warm bathing; which moſt effectually procures them reſt and reſtores their ſpirits after extreme fatigue.

§ 577. 3. No perſon ſhould ſtay longer in the bath, than he finds it refreſhing and invigorating. Except ſuch as are bitten by mad dogs or other inraged animals, or maniacs, whom it may be found neceſſary ſometimes to continue in the bath, until they grow faint.

§ 578. 4. All perſons ſhould be forbidden much active motion or ſpeaking in a warm bath; as it greatly exhauſts the ſtrength and diſtreſſes the organs of breathing, then under a conſiderable additional preſſure to that of the atmoſphere, and repleniſhed with the rarefied juices.

§ 579. 5. No perſon, except maniacs and thoſe bitten by inraged animals, ſhould be forced to bathe,

which I here tranſcribe,—Aer calidus et lavacra actu calida, niſi obſtent cruda, juvant quoque perſpirationem, refrigerant interna viſcera, et corpora efficiunt leviora.

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when it raiſes any degree of Terror or Horror[a], nor at the approach of any epileptic or other convulſive fit; becauſe thoſe inordinate orgaſms of the ſpirits may be greatly increaſed by the dread of the bath.

§ 580. 6. No perſon with full bowels or blood veſſels, or with any inflamed, obſtructed or much weakened bowel, ſhould be admitted into a cold or warm bath; leaſt crudities, in the firſt and ſecond paſſages, ruptures, hemorhages, or an increaſe of thoſe diſorders, may be the conſequences[b].

§ 581. 7. The head in general is to be kept out of the warm bath, dry and ſlightly covered; and in ſome caſes, it is to be left bare, or covered with a napkin wet with cold water; as where the patient is ſubject to influxes of blood on the brain, or eyes, to pains in the head, drowſineſs, &c.

§ 582. 8. The reſt of the body ſhould be quite naked; except a convenient little garment, which may be carried betwixt the thighs, and ſupported by a piece of tape about the waſte, before and behind, to hide thoſe parts, which modeſty bids us conceal from each other's ſight. Whoever goes into a bath, hot or cold, particularly the former, in any, eſpecially a tight or cloſe, garment, does not receive half the benefit, he might expect. The efficacy of warm bathing, in a great meaſure, depends upon having a conſtant ſucceſſion of new water coming into contact with the ſkin, while a perſon remanes in the bath. But, when one goes into a bath in a cloſe veſtment, he is to expect little or no more water to come into contact with, and to diſſolve and waſh away the foulneſs of, his body, than what his garment, at firſt immerſion, receives, which it holds, until he makes his exit. This conſidered, I ſhould be glad to hear how the modeled practicioners, who countenance or connive at the ſexes bathing promiſcuouſly and in ſtiff, cloſe, canvas habits, can reconcile this cuſtom to decency and common ſenſe: I ſhall not require their reconciling

[a] GALEN. de morb. cur. lib. xi. [b] GALEN, part laſt cited.

it to the rules of phyſic; it would be moſt unreaſonable to demand an impoſſibility.

§ 583. 9. The next thing to be conſidered is the regulation of the temperature of the Bath. On this greatly depends the recovery and ſafety of the patient: And it is not difficult to be done; ſince, by the uſe of the Thermometer, every degree of heat and cold can be ſo eaſily and effectually aſcertained, that where baths are regularly conſtructed and rationally conducted, the phyſician can direct the degree of heat of the bath for his patient, with as much certainty, as the number of minutes, he would have him remane in it. How this is to be done, where the baths have none other covering, than the extended canopy of heaven, let any thinking man conſider. What phyſician or patient can be ſecure of the neceſſary degree of heat in the water, two days ſucceſſively, or any two hours in any one day, in the naked baths of our Bath? What chance of performing cures there, in the cold ſeaſons eſpecially, which are the chief times deſtined for bathing in thoſe open ponds of uncertainly heated waters; ſo little, if at all, improved ſince the times of our hardy, barbarous anceſtors the Britons? But, no more of this, until we come to treat expreſly on theſe powerful, unknown, though much frequented and abuſed, waters. Let me here onely give this general caution in the uſe of baths, that no perſon goes into any bath, heated above ninety-four degrees, which is found to be the heat of the blood in the natural healthful ſtate, taken by Fahrenheit's thermometer; unleſs it be expreſsly directed by a phyſician upon ſome extraordinary emergency, to increaſe the degree of heat.

§ 584. Under this head, two other kinds of warm bathing; to wit, 1. the pump, and 2. the vapor bath may not improperly be conſidered.

§ 585. 1. The firſt form of bathing was known to the greeks by the name of ἤμβρεγμα and ἐμβροχὴ, Embregma and Embroche; to the romans, by thoſe of Stillicidium, Inſtillatio and Irrigatio; and is now called,

called, by the Italians, Doccia, by the French, la Douche, and by the Germans and us, from the ordinary manner of applying it among us, die Pompe, the Pump.

§ 586. By this, is meaned a contrivance, by which any convenient liquor, but chiefly water, cold or hot, may be cauſed to deſtil, run or fall, from ſome diſtance, upon the whole, or any part of, the body.

§ 587. The beſt method of making this kind of bath is by raiſing the water of any natural or artefi-cial bath into a receptacle of a convenient ſize and heighth, by means of a pump or other proper machine. This receptacle is to be furniſhed with one or more flexible tubes, to which may be occaſionally adapted, cocks with one, or many orifices of different dimenſions and forms, to apply the ſtream of warm water in any proportion, direction, or force required, to any part affected.

§ 588. Here then, is added to the ſoftening, reſolving and penetrating power of water, that of friction; by which it is capable of doing inexpreſſible ſervice in old hard and cold tumors, ſtiffneſs and contraction of the joints, gout and rheumatiſm.

§ 589. The patient may either ſit or lye in the bath, or out of it, as is found moſt convenient, to have the ſtillicidium applied to the particular part affected. And the ſame cautions are to be uſed to avoid cold after this application, as after general bathing.

§ 590. The power of the friction of the water may be greatly increaſed, by forcing it by any proper pump into a braſs or copper ſphere, to which a cock with a flexible leathern tube is fixed; by which the water may be driven by the ſpring of the incloſed air in the ſphere, added to the gravity of the water. By this means, this method of applying water muſt be rendered moſt effectual in old, hard, indolent tumors, contractions, &c.

§ 591. 2. The ſecond is a form of bathing not known or uſed among us; though the moſt powerful, the moſt effectual of any.

§ 592. This ſeems to have taken riſe among the Romans, in whoſe immediate territories, nature furniſhed many vapor baths; as in ſeveral places about Naples, Puteoli, the Bajae, celebrated by HORACE and CELSUS, with many others of inferior note. Theſe were called by the names of Vaporarium, Laconicum, and Sudatorium; in faint imitation of which, were contrived the ſtoves, afterwards called by the ſame names, as well as by thoſe of Stupha, or Stuffa, the later by the Germans, who invented them in imitation of the natural, and called them Badtſtuff, in their language, and in a ſort of fictitious latin, Stuffa.

§ 593. This is certainly the moſt ſafe and effectual ſudatory known: Nor can there be an inſtance given of its failing, in fit ſubjects, under due regulation. We have already had occaſion to explane the operation of warm baths; whatever holds true of them, holds alſo good in the vapor bath. This may eaſily be conceived, upon recollecting what has been ſayed of the power of water converted into ſteam, in Papin's digeſter and other more common machines. By this means, the hardeſt part of animals, may, in a ſhort time, be reſolved into a gelly. Hence, the reſolving power of the vapor of warm water upon an animal body may be judged. This vapor ſtriking againſt the body is partly condenſed into water, whileſt a part enters the pores. When the vapor is confined about the whole body or any part thereof, it muſt act more powerfully. It then warms, ſoftens, relaxes, opens the pores, penetrates the remoteſt receſſes, reſolves and attenuates viſcid and cold humors univerſally, and fits them for a diſcharge by the ſkin, in a bland and copious ſweat, partly in the bath and partly in bed after it. By this means, paralytic diſorders ariſing from any viſcidity of the juices, anaſarcous and oedematous tumors, whether partial or univerſal, pains and contractions of the limbs or joints, and numberleſs other evils of this claſs are moſt happily and effectually relieved.

§ 594. From the many inſtances of the ſalutary effects of warm vapor bathing, which I had obſerved

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at Aken, I was induced to contrive a ſudatory upon the ſame principles with theirs; judging, that the efficacy of their vapor baths was not ſolely owing to the ſubtil, mineral effluvia, with which they are charged, but chiefly to the particles of water moſt ſubtilly attenuated and ſet in motion by heat; or at leſt, that a ſimple vapor bath might probably produce very deſirable effects.

§ 595. This ſudatory conſiſts of a kind of chair made of four planks or pannels, of about two feet four inches broad, and about five feet in length or height. Theſe are cloſely joined together by hinges; ſo that they may be folded up for the conveniency of carriage, or placed upright and by hooks faſtened to a ſquare Plank, that ſerves for a bottom or foot-board; and then, one pannel makes a back, two others conſtitute the ſides of the chair, and the fourth ſerves for a door. To this chair there is a ſliding ſeat, with a thin ticking ing bottom, that, like the moveable ſhelf of a library or book-caſe, may be raiſed higher or placed lower, according to the ſize of the patient. At the top, there is ſuch another contrivance; but the board, which fills the whole ſpace, is placed ſhelving, from the back forward, for the greater freedom in breathing; and is divided into two, each part of which is hollowed to the ordinary ſize of an human neck. This is adapted to the ſize of the patient; the back-piece is put in firſt, the patient is then ſeated, naked on the ſeat, and the fore part is added. Then the door is cloſed and the vapor admitted by the means of the following aparatus, which conſiſts of,

§ 596. 1. A flat copper kettle to hold about ſix quarts, to which an head is adapted ſomewhat like that of a common alembic; but with a ſmaller head in proportion; as it is not deſigned for condenſing, but conveying the vapor by a tube, of about three inches in diameter, continued from the head into the lower part of the back of the ſweating chair, and by moveable pieces turned in any direction deſired. About the neck of this kettle, there is an opening, by a ſhort

pipe

pipe of about an inch and half in diameter; by which a ſupply of new hot water may be given without interruption; or the vapor medicated by the addition of any ſpirit or other volatile, aromatic medicine; or the heat moderated or ſtopped, by the addition of cold water, at diſcretion.

§ 597. 2. A low copper ſtove or little furnace with its fire place, aſh hole and regiſters, made to receive the bottom of the above kettle, and to hold fire enough to keep the contents boiling; yet, ſo as, by ſhutting its doors and regiſters, the fire may be in an inſtant ſuppreſſed and the boiling and vapor made to ceaſe.

§ 598. The patient ſits naked in this chair, with a napkin about his neck to keep the vapors from coming out and anoying his head or lungs; and may be continued in it, and ſupplied with drink or cordials, according to the preſcriber's intentions.

§ 699. It is eaſy to ſee the different advantages this holds from the common ſtoves or hot-houſes in Bagnios; where the head and lungs of the patient muſt be injured by the heat and by breathing ſuch an highly rarefied and offenſive air, as muſt be in ſuch hot and confined places. Beſides, in this, you may have the moſt abſolute power over the ſudatory, by admitting more or leſs vapor, ſimple or medicated, at diſcretion, or by totally ſtopping its courſe: Which can not be done in the common ſuffocating ſtoves at the Hummums.

§ 600. By contriving boxes to contain particular affected limbs, a partial vapor bath, ſimple or medicated according to the preſcriber's intentions, may be readily adminiſtered; than which, there can not be a better, nor, in many caſes, ſo good a Fomentation.

§ 601. By different pieces of tubes, ſome ſtraight, others angular, with a roſe, like that of a gardener's watering pot, ſuch a vapor may be conveyed to any part of the body. And I am perſuaded, that by ſuch a vapor properly conveyed to the ears, many pains of theſe parts and deafneſſes may be cured, that do not give way to any other known form of medicine.

§ 602.

§ 602. This ſmall machine, I have contrived to make it portable. But, it is not difficult to make it more effectual by inlarging upon this plan. And, if what I have here offered upon the uſe and efficacy of water variouſly applied in the relief or prevention of the almoſt numberleſs diſorders incident to the frailty of human nature, may be hoped to have any weight, we may expect to ſee all the neceſſary conveniencies for the ſeveral kinds of baths eſtabliſhed in every conſiderable houſe in the country, and regular and well-furniſhed Bagnios encouraged and ſet up in every town. And, that the poor may not be excluded the benefit of the helps, which are to be drawn from this quarter, at a moderate expence; I beg leave to recommend it to the public to extend their benevolence to their ſuffering fellow creatures; and, by a charitable contribution, eſtabliſh public baths, both cold and hot, to which the poor may have eaſy acceſs. It would likewiſe be not onely an act of great and true charity, but the beſt policy, to eſtabliſh proper baths in all bridewels, goals, and other places of confinement; where, by obliging the wretched, who from filth and naſtineſs, contract the moſt malignant and peſtilential diſeaſes, frequently to waſh and cleanſe themſelves, much of the calamity, and the dreadful infection may be obviated, which they ſo commonly ſuffer and ſo often impart to the reſt of the ſociety, in general goal deliveries. It is alſo, in mine apprehenſion, to be wiſhed, that many of thoſe, who are confined in various diſeaſes in hoſpitals, were put upon the ſame cleanſing, wholeſom regimen; and that our ſailors, in long voyages, were obliged to make frequent bathing a part of their ſalutary diſcipline; which would certainly help to keep them free from ſcurvies and other diſorders, to which they are found too ſubject.

§ 603. I ſhall cloſe this part of my diſſertation with an obſervation and propoſal, which I think extremely conducive to the end propoſed by this and all my poor labours, the common good of the Republic.

§ 604.

§ 604. I presume, it must be obvious to every reader, who has attentively read this tract, thus far, that there is nothing known, that bids so fair for the character of the much, but vanely, sought universal remedy, as common water; since nothing is found so necessary to life, so effectual in preserving present, or restoring lossed health, as water.

§ 605. I therefore venture to recommend its more frequent use to the public in general, and that it may be further introduced into practice in our hospitals in particular, than it is at present found. But, if from the constitution of particular foundations, which I look upon to be so sacred, as to be, for the most part, unalterable; this may be found in most impracticable, I humbly propose it to the consideration of BRITONS, more remarkable, more justly famed for public benevolence, for making provisions for the health of the bodies and minds of the indigent, in the erecting alms-houses and hospitals, scholes, colleges and other seminaries of literature and arts, than any other people, or perhaps, than all the other nations on the globe united can boast; to erect and establish, in the capital and other great cities, one or more Bath or Water-hospitals; where physicians, with proper attendants, may be appointed, and poor in all fit cases, at all times readily received and supplied with light, simple diet, clean beds, baths of all kinds, and water simple and variously medicated of different degrees of heat and cold adapted to the generality of cases, that may offer.

§ 607. Such an hospital may be built, planely and elegantly, contiguous to a navigable river for the sake of fewel, and may be supported at a much less expence, than any of the present foundations, and may vie with any of them, if not outdo most, in utility and benefit to the public.

The End of Part I.

AN

ESSAY

ON

WATERS.

PART II.

Of Cold Medicated Waters.

AN

ESSAY

ON

WATERS.

PART II.

OF COLD MEDICATED WATERS.

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PART II.

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AN ESSAY ON WATERS.

PART II.

Of MINERAL WATERS *in general.*

The INTRODUCTION.

§ 1. ALTHOUGH water in general be looked upon as a terreſtrial or mineral body, by the beſt naturaliſts; yet, are we forced, for diſtinction, in ſome inſtances, to denominate it from thoſe parts of the creation, from whence it is more immediately delivered to us, or preſented to our view: Thus, have we diſtinguiſhed the waters in the firſt part of this Eſſay into meteoric, atmoſpheric or aerial and terreſtrial; confining ourſelves ſolely to the inſipid, or as they are commonly called, the ſimple or ſweet waters, uſed in the common oeconomy of life.

§ 2. But, for better diſtinction, the waters of the later denomination, the terreſtrial, are to be ſtill further ſubdivided into ſapid, compound or medicated,

or as they are commonly called, Mineral waters; which are reſerved for the ſubject of this ſecond part.

§ 3. Unaſſiſted nature teaches us by our ſenſes to diſtinguiſh, the ſimple from the medicated waters. But, the alwiſe Author of nature has not left the inferior part of his creation void of this neceſſary knowledge; for, the brute, by what philoſophers are pleaſed to call inſtinct, knows as well the water, as the food, that is fit for ſuſtaining life and health, and probably the medicine neceſſary to reſtore loſſed health. Marks then, are ſet by the creator upon the mineral waters, to teach his creatures how to diſtinguiſh them from thoſe, that are deſtined for the ordinary uſes of life. And to man is given the art of applying them to extraordinary purpoſes.

§ 4. Though our ſenſes are never acurate enough, as ſome [a] have vanely imagined, to point out, with certainty and preciſion, the ingredients, with which a water is impregnated to bring it under the denomination of mineral; yet, do they ſufficiently inſtruct us how to diſtinguiſh them from the ſimple: As we take them to be ſimple, in which we can diſtinguiſh no ſenſible color, ſmell or taſte; ſo we call them mineral, that are ſenſibly altered in all, or any, of theſe qualities, and thereby recede from the character of ſimple water.

§ 5. When then, a water is ſenſibly charged with any foſſil or terrene body, of a liquid or ſolid nature, or with any thing reſulting from the ſolution, decompoſition or deſtruction of one or more mineral bodies; it is called, a mineral or medicated water; it is ſeparated from the ordinary, and ſet apart for the extraordinary, the medical, uſes of life. Such waters may be generally known by ſome of the following ſigns;

§ 6. 1. They are in their ſources covered with a pellicle or ſcum of one, or variegated with more colors;

[a] Baynard and Floyer.

§ 7. 2. They

§ 7. 2. They depoſite ſomething foregne to the appearance of the ſoil, and ſtill more foregne to the nature of pure water, in or about their ſprings and courſes;

§ 8. 3. They are generally found bright and pellucid, as the pureſt ſpring; ſometimes as foul as ſtagnant water;

§ 9. 4. Sometimes, they have ſomething remarkable in their color, whereby they are readily diſtinguiſhed; though they are moſtly found colorleſs;

§ 10. 5. Every mineral water diſcovers ſomething foregne in the taſte, by which it is readily known from pure water. And,

§ 11. 6. It is rare to find a mineral water quite void of ſmell: For, though many of the mineral waters, whileſt cold, appear ſcentleſs; yet, being heated, moſt of them ſtrike the ſenſe of ſmelling with ſomething different from the vapor of pure water;

§ 12. 7. In their ſources, they rarely, if ever, congele, or are perfectly frozen.

§ 13. Thus in general, are mineral waters to be diſtinguiſhed from the ſimple; when we come to treat of individuals, we ſhall be more particular.

§ 14. Great pains have been taken to claſs mineral waters methodically, agreeable to a ſyſtem formed from their diſtinguiſhing characteriſtics. But, from the infinite variety of combinations, that may be conceived from the general idea of ſalts and the trial and choice of waters introductory to the firſt part of this eſſay; the difficulty and uncertainty of ſuch a work may be readily judged. And if we conſider the ſucceſs of thoſe, that have gone the greateſt lengths in this deſirable work, among whom that celebrated Naturaliſt and Chymiſt, Dr. JOHN GOTSCHALK WALLERIUS, Profeſſor Royal of Chymiſtry, Metallurgy and Pharmacy in the univerſity of Upſal, moſt deſervedly bears preeminence; we ſhall be further diſcouraged from the laborious, if not endleſs, taſk.

§ 15. This learned and judicious phyſician, in his invaluable Mineralogy, has reduced all the waters, as well as other minerals, that fell under his cogniſance, into claſſes. But, it is plane, from this ingenious work itſelf, that nothing is more difficult than the claſſing of waters ſyſtematically.

§ 16. A ſyſtem, that is not proved or demonſtrated by the ſenſes, can be but of little uſe in this reſpect. Little, with regard to the infinite variety of impregnations of waters, which are already, and ſtill remane to be, known; can be diſcovered by the ſenſes. By theſe then it is plane, we can not find characteriſtics ſufficient to diſtinguiſh a great variety of waters, the one from the other. Are we then to diſtinguiſh them from the various matters, with which they appear charged upon a chymical analyſis? This can aſſuredly be the onely method, and this WALLERIUS took. But, when a water is found impregnated by and with different kinds of volatile parts; ſuch as a ſubtil, volatile, aerial or etherial ſpirit, and the volatile and fixed vitriolic acid, with different earths and ſalts, and with the phlogiſton, which, till now, has not, that I find, been thought, much leſs ſought, in water; from which ingredient ſhall we denominate the compoſition? If we were confined to waters ſimply ſpirituous, whether acid, alcaline or neuter, or by the means of any ſuch ſpirit charged with any one or even two ſolid ingredients in ſolution; if we had waters by the means of the more fixed acid, acidulated onely, or even charged with one oppoſite ſalt, with one earth or one metal; or, if the unions, we find of theſe acids, earths, metals and ſalts, were ſuch as to leave us a mixture of any one determinate kind upon evaporation, or other trials; ſuch a ſyſtem may be formed to very good purpoſe. But, the variety of ingredients, proportions and combinations are ſuch, that I can, at this view of the matter, hardly hope for any thing perfect or very ſatisfactory in this way. It is not difficult to conceive, to find and demonſtrate,

upon

upon analyſis, how and in what manner, various, if not moſt, mineral waters are impregnated, and what relation they then bear, the one to the other; but, how to denominate them intelligibly, is what I have not yet been able to conceive. And the great WALLERIUS's not ſucceeding to my judgment is enough to blaſt all mine hopes of ſucceeding ſatisfactorily in this matter.

§ 17. In order to a more eaſy and right apprehenſion of this affair, let any one enquire, what this author means by Aqua foſſilium ſulphurea, or Aqua ſulphurea[a]. If I underſtand him, he means that, of which I have no clear conception, though it is familiar in the mouth of every body in this way; a water actually impregnated with common ſulphur. We know no means, by which ſuch a ſolution can be effected, but that of alcalies. And we know, that no man has yet demonſtrated ſuch a water or ſuch a ſolution in nature; and that when ſuch are prepared by art, they are always colored yellow, and in evaporation leave no ſulphur behind them. If there had been ſuch an impregnation known in nature, the ſagacious and accurate WALLERIUS muſt ſurely have pointed out where. But, he has not; whence, I muſt judge, that ſuch a water has not yet come under any man's cogniſance; and therefore, that no natural ſyſtem can properly take in this denomination, in this ſenſe.

§ 18. The author is in his ſyſtem forced to fall into abſurdities and contradictions, even in terms.—Every naturaliſt knows, that by the term Acidulae, are underſtood waters, which imprint a ſubacid taſte upon the palate. This antique expreſſion has been contradicted and even ridiculed by ſome moderns[b], with great

[a] Hydrology, p. 90, 91.

[b] HOFFMAN de element. aquarum mineral. recte dijudicand. et examinand.—De princip. et virtutib. praecipuor. medicator. german. fontium.—De convenientia elementor ac virium in Thermis et Acidulis;—et poſſim; preſertim in tractatu primo citato, in quo aſſerit,—Neque enim, quod primus omnium ego obſervavi, purum acidum

great injuſtice: For, becauſe waters of this taſte are found in ſome manner to turn ſyrup of violets green, and to give further proofs of containing an alcali, upon various trials; they would have the name changed. But, this is for want of due acuracy: For, we ſhall be able to ſhew in the ſequel, that ſuch waters are, not onely to the ſenſes, but upon the ſtricteſt trials, acidulae, ſubacid waters; or waters, in which, in the natural ſtate, a ſubtil, volatile acid predominates. We alſo know, that there are fixed and volatile alcalies in the bowels of the earth, and that waters may be, and actually are, found charged with this acid, or with one or other of theſe alcalies; whence very proper denominations may be, and really are, given them. But, when theſe are found pretty equal in waters, under what ſyſtematical appellation are they to be compriſed? In this, our author is obliged to fall into inexplicable confuſion.—No ſyſtem can be of real uſe, that does not convey clear and determinate notions of the matter treated, at firſt ſight. We can well conceive this, and every author, when he calls a water ſaline, muriatic, vitriolic, acid or ſubacid, alcaline, neuter, &c. But, what are we to think when incongruous epithets are joined? We may then well conceive our author's meaning under any of the aforeſayed ſimple and expreſſive denominations; or even when he couples them, as he may and does, with other epithets, as alcalinae ſimplices vel ſulphureae; alcaline waters ſimple or ſulphureous; which may be compoſed of a volatile or fixed alcali. But, what ideas can we affix, when diametrically oppoſite qualities are compriſed under the ſame denomination? Such as, Acidulae alcalinae ſimplices, ſimple acid and alcaline waters? Acidulae alcalinae calcareae, acid alcaline and calcarious waters? Acidulae neutrales, neuter

acidum in acidulis deliteſcit, ſed omnes, quotquot ſunt et dicuntur, in omnibus Europae locis, ſal alcali vehunt, ut potius alcalinae dicendae aſſent. p. 138. § xl.

or

or neutral acid waters? Acidulae neutrales ſimplices, ſimple acid, neutral waters? Acidulae neutrales alcalinae, acid, neutral, alcaline waters? Acidulae neutrales calcareae, acid, neutral, calcarious waters? And others of the like kind? — That there are waters thus diverſly impregnated is confeſſed, and ſhall be demonſtrated in the ſequel. But, the previouſly claſſing them under theſe diſcordant, contradicting and confuſed appellations, in mine apprehenſion, can hardly anſwer any uſeful purpoſe. Nor do we come much nearer the knowledge of the truth, by the author's method of claſſing of baths; when the waters of Aken are brought under the denomination of Thermae alcalinae ſulphureae, alcaline, ſulphurous baths; when it is demonſtrable, they contain a conſiderable quantity of the volatile vitriolic acid; without which, they had, in no ſenſe, deſerved the name of ſulphureous. And when the waters of Bath and Buckſton are brought under the ſame denomination of Thermae neutrales muriaticae, neutral muriatic baths, which are found of very different impregnations and qualities; and others as inexpreſſively under that of Thermae neutrales alcalinae, neutral alcaline baths. As for his Acidulae martiales vitriolo fugaci, ſubacid ferrugineous waters with a volatile vitriol, we ſhall ſpeak to them elſewhere.

§ 19. Hence, we may then ſee, how little helps we are to expect from carrying the variety of mineral waters into theſe like ſyſtematical diſtinctions, which rather confuſe than clear our ideas. Wherefore, I ſhall confine myſelf to fewer and more obvious diſtinctions; for various reaſons; particularly this; that as I am not giving a general account of mineral waters, but a particular one of the few, that have fallen under mine obſervation; ſuch a work is not to be expected here.

§ 20. Mineral waters are either cold or hot. It has already been ſhewn, that water requires a certain degree of heat to preſerve the principal characteriſtic

of

of water, fluidity. All that we mean here by cold waters, are onely ſuch as are always found cold or colder than the ordinary heat of the atmoſphere in ſummer.

§ 21. On the other hand, all waters that are found ſpontaneouſly, in any degree warmer than the incumbent atmoſphere, in ſummer, come under the denomination of hot mineral waters or baths.

§ 22. As heat is but accidental in any water, the hot may be impregnated with the ſame principles as the cold, and the cold as the hot, waters. And ſo we find them.

§ 23. When we conſider the infinite variety of matter of which the terraqueous globe, we inhabit, is compoſed; the continual revolution, the perpetual ſucceſſion of creation or generation, and of deſtruction, or rather diſſolution and corruption, that muſt attend ſuch a medley; where the diſſolution of one body conſtantly furniſhes out materials for the production or revivification of another; we may with greater eaſe comprehend the different combinations of matter, with which mineral waters may be charged.

§ 24. But, when we come to conſider the different degrees of ſtability and ſolubility of the various matters, that have yet fallen under human obſervation, and the few ſolvents of ſolid bodies, which the creator has ſupplied; we may form ſome judgment of the limits to be ſet to theſe like impregnations; as we know a very great number of mineral bodies, for which no proper ſolvent has yet been found in nature. Thus, we find not onely the gems, but many of the metals, are deſtitute of fit ſolvents in nature. Whence, as yet it appears vane to look for gold, ſilver, tin, lead, quickſilver or antimony in any natural water.

§ 25. This, with other relative truths, has been briefly ſet forth in the idea of ſalts and the trial and choice of waters, in the preceding part of this eſſay.

From

From theſe, the various impregnations and their bounds may be better conceived.

§ 26. I ſhall here therefore onely point out ſome impregnations, that might not ſo properly be inſiſted upon there, and then procede to lay down the order, I judge moſt natural and convenient to follow in the ſucceding part of this work.

§ 27. We find waters impregnated with and by ſubſtances, which, though they may, in a ſtrict ſenſe, come under the denomination of ſalts; yet, as they partly never, and partly rarely, if ever, occur in nature in a concrete form, or in any manner ſo ſeparated from air or water or both, as to come under a very evident examination; we ſhall give them a word or two apart in this introduction, to help the clearer underſtanding of the ſequel.

§ 28. We find then, waters impregnated with certain ſubtil, volatile principles; which for want of a better appellation, and to conform with cuſtom, to avoid confuſion, we ſhall call ſpirits; and as they are the reſult of the diſſolution or decompoſition of ſome foſſil or mineraliſed body, though ſometime of the vegetable or animal kingdom; we ſhall call them mineral; as we call water, confeſſedly mineral, ſometimes for diſtinction, meteoric or aerial.

§ 29. 1. The firſt and ſimpleſt of theſe is that moſt ſubtile, volatile fluid, which is known to naturaliſts by the different appellations of ſpiritus volatilis mineralis; the volatile mineral ſpirit; ſpiritus aethereus, vel aethereo-elaſticus mineralis; the etherial, or ethereo-elaſtic mineral ſpirit, or anima aquarum mineralium; the life or ſpirit of mineral waters. And probably is the ſpiritus luti caerulei, the ſpirit of blue clay or loam of BECHER, before mentioned.

§ 30. This is ſometimes found in waters, which to vulgar obſervers, appear ſimple, becauſe colorleſs, inodorous and inſipid. Water charged with this ſpirit is always as light or lighter than rain water or dew. It is diſcovered by its extreme volatility: No ſooner is it removed from its ſourſe into air, but the leſt de-

gree warmer, than it immediately manifeſts itſelf by ſeparating and flying off in ſmall air bubbles; which ſparkling, partly paſs through the water and eſcape at the ſurface, and partly remane under the preſſure of the water, a while adherent to the bottom and ſides of the containing veſſel. If ſhaken, it diſcharges more of theſe bubbles, ſo as ſuddenly to cover the ſurface with them; where, being eaſily rarefied by the warmer medium, they quickly vaniſh. If agitated or heated in a ſtopped bottle, with a narrow mouth, and not quite full; upon opening it ſuddenly, this ſpirit flies off with force and noiſe, which diminiſh upon every repetition, till about the third or perhaps the fourth agitation, the ſpirit being diſſipated, as it is at once upon heating, the effects totally ceaſe.

§ 31. If the water thus impregnated be ſet in an open veſſel over the fire, the air-bubbles riſe, as ſoon as the fire can act upon it, and following one another in a quick ſucceſſion, fly off and riſe viſibly above the ſurface of the water, with a ſlight exploſion. The motion of the water will then become ſo ſenſible, that before it become perceptibly warm, it will ſeem to boil. If the veſſel be ſtopped, it will burſt with an exploſion, long before the water gets any ſenſible heat. The ſpirit being by any of theſe means diſſipated, the water amits of its pellucidity in proportion to its terreſtreity; and in one ſenſe, loſes of its weight, in another, increaſes it: Thus, for example, the water ſo ſpoiled of its ſpirit, reſtored to its natural coldneſs, will be found volume for volume heavier, than before. But, if the new drawn water be readily and carefully weighed in cold air, in a glaſs; that glaſs placed under the receiver of an air-pump and exhauſted of its ſpirit, then weighed again, it will be found to have loſſed of its weight, which weight determines the deficiency of its volatile ſpirit.

§ 32. Some of our common ſprings are charged with this ſubtil ſpirit; though it generally paſſes unobſerved.

obſerved. I know of no ſimple water ſo plentifully endued with it, as a pure cold ſpring upon the banks of the river Avon, over againſt the hot wells of St. Vincent's rock. It is in greateſt plenty in the waters called acidulae; but there, it is not ſimple, but complicated with the volatile vitriolic acid, and ſometimes with phlogiſton.

§ 33. As it is ſo ſubtil, as to be almoſt incoercible, impoſſible to be ſeparated and kept by itſelf, and even to be retained long in the water, after it has been removed from its ſource or otherwiſe expoſed to a warmer air; it is not eaſy to examine the nature of it, with due preciſion. Such waters as are impregnated with this alone, hardly change the color of ſirup of violets. But, ſuch are hardly ever ſo free from terrene matter, as not to work a change in color by ſtanding ſometime with this ſirup; they generally turn it green. From this cauſe, this ſpirit is generally looked upon to be alcaline, and that of a peculiar nature, differing from the common urinous volatile alcali; in being void of that ſmell and being of origin not yet clearly known. Waters containing this ſpirit of the alcaline kind, like the urinous or animal volatile alcali, precipate ſolutions of corroſive ſublimate white. They alſo in general undergo an ebullition upon the admixture of acids; but, that is not ſufficient proof of alcaleſcency; ſince charging them with alcalies or with any ſalt, even with ſugar, will produce a ſimilar effect; for, whatever excites any degree of heat, or renders the watry medium heavier than before, muſt expel this moſt light and volatile fluid. Theſe waters are the lighteſt and beſt of any, and may be applied to all the purpoſes of pure water with deſirable ſucceſs. The extraordinary medicinal virtues, ſuperſtitiouſly aſcribed to ſome ſprings from the influence of ſome legendary ſaint, may, when true, be found owing to this ſubtil matter and pure water alone, without any preternatural or miraculous cauſe, to which the ignorant are, upon all occaſions, fond of having recourſe.

34. 2. The ſecond of theſe is a volatile alcaline ſpirit, with which waters are ſometimes, though rareſy, ſo ſenſibly charged, as to be diſcovered by the ſenſes of ſmelling and taſte. It is likewiſe diſcoverable by an ebullition, which ſuccedes upon the admixture of acids, and by its turning ſirup of violets green, and cauſing a milkineſs and white precipitation in a ſolution of corroſive ſublimate.

§ 35. Moſt naturaliſts deny the exiſtence of a volatile, urinous alcali in the mineral kingdom. But, moſt unjuſtly; ſince its actual exiſtence, as well as its origin, are both eaſily demonſtrated. Many loamy earths are in ſeveral places charged with this ſalt. All bodies, that contain ſea-ſalt have more or leſs of it. And not onely all the petrifications or mineraliſations of vegetables and animals, that now make a great part of the foſſil world, but all limeſtones, marbles, ſpars, clay, chalk, marle, ſlates, &c. yield it in plenty upon calcination or deſtillation. It is likewiſe produced by the calcining or deſtilling together chalk, lime-ſtone, or lime, vitriol and ſea ſalt, or lime and ſea-ſalt alone. And, as theſe materials are every where plenty in the earth; wherever they are found, and there has at any time been fire to operate upon them, there a volatile alcali muſt be found. But, this is not to be ſought in a concrete form: For, as it is extremely volatile, it muſt always fly off, where it does not meet with ſome impediment to arreſt it. Meeting with acids in its paſſage, it attracts them, and they uniting form an ammoniacal ſalt. Sceptics may be ſatisfied of the exiſtence of this alcali, by the quantity of native ſal ammoniac found in various parts of the earth; eſpecially about ſubterranean fires. This ſalt is well known to be compoſed of a volatile urinous alcali and the acid of ſea ſalt. If there were no natural volatile alcali, we could have no natural ſalt ammoniac. But, we have the one, and can not therefore be denied the other.

§ 36.

§ 36. Moreover, there are waters actually impregnated with a volatile alcali, ſmelling as offenſively as a ſwine-ſtie. We have a ſpring of this kind near Franckfort on the Mayne, called, Faul-Brunn, the putrid ſpring, as WALLERIUS notes[a]; who cites HENCKEL's tract intituled, Betheſda Portuoſa, for a ſimilar inſtance in the waters of Lauchſtadt and ſome others in Germany.

§ 37. Beſides the ſmell, the ebullition with acids and turning ſolution of corroſive ſublimate milky, which characteriſe a water impregnated with a volatile alcali; there is another ſign alſo, which is its diſſolving copper, and turning ſolutions of that metal in acids, of a bright ſaphirine color.

§ 38. 3. In the general idea of ſalts[b], mention has often been, and muſt ſtill be oftener hereafter, made of the volatile vitriolic acid. It comes here again not improperly under our conſideration. This ſome look upon as the mineral ſpiritus rector, or preſiding ſpirit of the mineral creation, in the language of the alchemiſts; though that appellation ſeems more properly to appertain to the phlogiſton. This procedes from decompoſing vitriol, ſulphur or pyrites, and is ſo frequently mixed with the ſimple ethereal or elaſtic ſpirit, and ſo like it in its principal effects, that they are ſeldom or never properly diſtinguiſhed, and even are, by ſome of the beſt writers, often confounded together.

§ 39. This ſubtil ſpirit has every property of the more groſs and heavy vitriolic acid, but fixity. It has the ſame affinity or attraction with the ſame bodies, and works the like effects; with this difference, that the volatile ſpirit does not ſo firmly hold its union with the bodies it has diſſolved, or the ſalts it has ſaturated, as the fixed acid. But, flies off ſpontaneouſly from many, or may be propelled by different degrees of fire, with or without the interpoſition of the fixed acid, from all. Thus, though, as it eſcapes from

[a] Hydrolog. p. 72. [b] § 35, and foll.

the pyrite, it is capable of diſſolving iron and impregnating water therewith; yet, by the ſlighteſt additional heat, this ſubtil ſolvent flies off and forſakes the diſſolved iron; which therefore, falls in clouds of martial or ochrous earth to the bottom. Inattention to this property of this ſpirit, and to this change, gave riſe to that abſurd and ridiculous notion and expreſſion, of a volatile vitriol, which, to our ſhame, too univerſally prevales: For, wherever a water has been found to tinge purple, blew or black with galls or other aſtringents, and to leave no vitriol behind it upon evaporation, or to loſe this tinging quality upon being heated or kept open or long removed from its ſpring; this is attributed to a volatile vitriol, a ſubtil vitriolic principle, volatile ſteel, or ſome ſuch unmeaning non-entity. This acid gives no vitriol with either copper or iron; but the fixed acid does. By this alone, they may be diſtinguiſhed in any mineral water.

§ 40. This ſubtil acid it is, that gives the name and characteriſtics to the waters commonly called Acidulae or ſub-acid waters; thoſe of the chalybeate or ferrugineous kind eſpecially; ſuch as the waters of Pyrmont, Spa, Malmendy, Stavelot, &c. and to ſome that contain no metallic matter, but rather an alcaline or muriatic ſalt, an abſorbent earth or the like; ſuch as the waters of Seltz or Selter, Bonn, &c.

§ 41. It is diſcovered partly, but not without much care and caution, by deſtillation; the firſt part that deſtills, changes ſirup of violets to a roſe purple, obſcures or incompletely precipitates ſolutions of lead and ſilver; extracts the red color of roſes; and if turnſol-dyed paper be placed in the junctures of the alembic, it will be found ſpotted red.

§ 42. But, there is a ſimpler experiment, than any of theſe, that demonſtrates this acid in any water, in which it abounds; and that contrary to the obſervations and aſſertions of all the beſt writers. Some would have the name of Acidulae exploded; among other reaſons, becauſe all the waters, that come under this

this denomination, turn ſirup of violets green. WALLERIUS poſitively ſays, this ſpirit has this alcaline property. Though it be true, that waters impregnated with this ſpirit change this ſirup green; the reverſe muſt alſo appear fact to every careful obſerver. In the chalybeate waters abounding with this fine acid, ſirup of violets is changed to a fair green, and galls and other vegetable aſtringents ſtrike, in proportion to the impregnation, ſome ſhades of purple, blew or black. But, neither of theſe changes happen at firſt mixture: On the contrary, good ſirup of violets will ſhew, firſt a bright roſe purple, which almoſt inſtantly vaniſhing, leaves the mixture of the natural, neutral color, a pale blew, and ſoon after changes, gradually, to a ſea green, and then, to all the deeper ſhades, beginning always at the ſurface. A perſon muſt be quick and give a lively attention to obſerve the ſecond, and ſtill more to ſee the firſt change of color; the ſloweſt and moſt ſuperficial in obſervation all ſee the third and laſt; but, none, that I know of, ever before took the leſt notice of the two others.

§ 43. In like manner, few take notice, that the galls or their infuſion do not immediately tinge in the water ſtrongly impregnated with this acid; but, it is moſt certain, that at firſt the mixture ſhews no change; then gradually turns to a pale roſe purple, and ſo improves, according to the ſtrength of the impregnation, to a violet purple, deep blew, or black; beginning always towards the ſurface.

§ 44. Theſe obſervations planely diſcover this volatile acid predominant, at the time of beginning the experiments, in the waters; and therefore ſhew, that the antique term of Acidulae is in no ſenſe improper or inexpreſſive; even though upon its exhalation, an alcaline ſubſtance ſhould be found in the water. The change in the ſirup of violets, firſt to a roſe purple, and the not tinging inſtantly with the galls, are both owing to the ſuperabundance of this acid at the inſtant of making the experiment. Were it not for this,

the ſirup would change inſtantly to a green, and the galls would as ſoon ſtrike their dye. But, the conſequences evince the truth of this etiology: In proportion, as this acid eſcapes, the coloring effects are produced. The ſirup of violets recovers its natural color, when the water is brought to the neutral ſtate, by the flying off of a certain portion of the volatile acid; and at that inſtant it is, that the galls tinge. Then, ſoon after, the ſirup begins to get ſome ſhades of green at the ſurface, where the acid firſt gets off, and this procedes by ſhades, deepening by degrees, from the ſurface to the bottom; which can be attributed to none other cauſe, than the gradual exhalation of the acid, and that from the part of the fluid moſt in contact with the air. The ſame progreſs is made, rather more quickly, with the galls; till, in proportion as the water is charged with terrene matter, it ſooner or later lets the coloring matter precipitate. For further illuſtration of theſe truths, it is to be obſerved, that the water thus impregnated, by agitation, or lying ſome ſhort time expoſed to the air, to loſe its ſpirit; with ſirup of violets, ſtrikes inſtantly green, which change muſt have been before impeded by the acid onely: And, that the water, thus changed, ſtrikes inſtantly its deepeſt dye with galls, which was by the ſame cauſe before obſtructed. But, if the water lyes long enough open in a warmer place to loſe all the volatile acid; then it will not tinge at all with galls; not that the martial matter, the cauſe of this dye, is volatile, as generally ſuppoſed; but becauſe the acid ſolvent is volatile and flies off, leaving the metallic particles, no longer in a ſtate of ſolution, but in the form of a light, rediſh magiſtery, to precipitate.

§ 45. This acid is ſometimes ſo inodorous, as not to be perceived by the ſmell in the water. Thus it is found in moſt of the waters of Pyrmont, Malmendy, Stavelot, or Brue, Spa, Tunbridge, &c. But, not ſo abſolutely ſcentleſs, as not to ſtrike the ſenſes with ſomething different from common water upon heating. Some are found with ſuch a portion of the phlogiſton,

giſton, as gives proof whence they derived their origine, to the ſenſes; for, they give the putrid or ſulphureous ſmell, ſo far, as to have been looked upon to be actually ſulphureous; though they offer none other proof of an impregnation with this mineral or its inflammable part. Of this kind is the Geronſter ſpring at Spa.

§ 46. 4. The fourth ſubtil matter, with which we find ſome waters impregnated, is phlogiſton, or the inflammable principle. What is meaned by this, has been briefly explaned in our idea of ſalts[a]. Its exiſtence in water in this form, has not, that I find, been obſerved by any before; but is rather denied by STAHL. But, as this ſeems to be the Sulphur Principle of the antients; ſo I take it to be the ſulphur of all the medicated waters of the moderns; for, as far as I have been able to look into this matter, I have never found any water, however ſulphureous, it has been called or deemed by naturaliſts or chemiſts, that was impregnated with any thing, that bore more relation to ſulphur, than this principle; which I firſt diſcovered in the waters of Aken and the inferior ſprings of Borſet. This, under one modification or other, is the cauſe of the different ſmells, as well as of the various colors of bodies. It is the ſupport, if not the origine, of fire; and perhaps will be found the cauſe of electricity. Nothing will catch fire or burn, or ſuffer any change in the fire, that is not endowed, or more intimately or laxly connected with this principle. Where the union is moſt intimate, there the leſt change is undergone; as in gold, glaſs, &c. Where its union is more lax, there it readily flies off, as in ſuch waters, as contain it, and in all vegetable and animal bodies. By whatſoever means bodies are brought to a perfect diſſolution, they are reduced to their firſt principles. In the corruption or diſſolution of all bodies, this, as the moſt ſubtil and volatile, with the mercurial or metalliſing principle, firſt eſcapes and flies off. Thus it is

[a] Part I. § 12. 2.

firſt

firſt ſeparated from the maſs and then forms a new combination in the fermentation of vegetables. But, in the putrifaction of both vegetables and animals, and their ſeveral productions, it flies off. In like manner, in the combuſtion of all inflammable bodies, whether vegetable, animal or mineral, it is diſſipated, not deſtroyed; it readily conceives that motion, which produces what we call fire, and flies away in the vapor or flame. But, that we may not imagine it deſtructible, though of all known beings it muſt be confeſſed the moſt volatile; nor yet confound it with the groſs notions of ſome, who take oil or any oily matter for it; as ſome of the late analyſers of Bath water do; let it firſt be remembered, that principles are unchangeable or indeſtructible; and then, let us conſider what happens when any inflammable body is committed to a firm iron or earthen retort, and undergoes the utmoſt torture, that arteficial fire can give. All watery and oily parts will firſt deſtill; ſo will certain ſaline concretions, volatile alcalies, be formed in ſome, and with theſe tranſcend the helm and deſtil or ſublime. Neither this watery matter, which ſome idly call a ſpirit, nor this oil, nor this ſalt are principles; as our IMMORTAL [a] BOYLE has demonſtrated; they are compound bodies; each of which ſtill contains ſome portion, more or leſs of phlogiſton. But, after the remainder in the retort has ſuffered the utmoſt known force of fire; if the veſſels be ſound, and the junctures perfectly cloſe, the phlogiſton will be found, by all this force, as it were, inſeparable from the matter in the bottom of the retort, now reduced to a coaly ſubſtance; where it may ſeem ſo firmly connected with this terrene maſs, falſely looked upon by moſt chemiſts, as what they call, caput mortuum, a maſs void of all things but a dead earth; as to be in appearance either fixed there or thence totally diſpelled. But, ſuch is the attraction between this moſt ſubtil principle and the more fixed earths, that they can ne-

[a] Sceptic. chemiſt & mutabil. of princip.

ver

ver be ſeparated, but by the free interpoſition of the air.

§ 47. That the phlogiſton ſtill remanes in this reſiduum, or in common charcoal, ever ſo long ſuffering the force of fire in cloſe veſſels, is evident from either of them imparting it by fuſion to any metallic calx, which is metal ſpoiled of this principle: For, thus the metallic ſplendor and other properties are reſtored. And, that it may be propelled or diſſipated by fire, appears from the recalcination of this metal, which may again be reduced to a calx as before; or by the calcination of the reſiduum or coaly matter, which will leave nothing, but the fixed, vitrifiable or calcarious earth behind; the phlogiſton, and, with it, the mercurial or metalliſing principle being ſet at liberty by the intromiſſion of the air. By theſe, air is rendered noxious: As is obſerved, where charcoal is burned in a cloſe room. Perſons ſleeping in ſuch air have been frequently found dead: And others, working much in this vapor, without the benefit of free air, are ſeiſed with heavy pains in the head, oppreſſions and aſthmas.

§ 48. This principle, as before obſerved, is continually flying off from all bodies, that contain it, as they are by any means decompoſed, in open air. As all combuſtible bodies, as well as ſulphur contain it, it is highly improper, and tends to great confuſion, to call phlogiſton ſulphur or ſulphur phlogiſton: This is but one of the conſtituent parts of ſulphur, as it is of other inflammable bodies. Here, it is joined with the univerſal acid, with which it is found to have the ſtrongeſt attraction, in the proportion of about one to fiveteen. From this acid, it is onely ſeparable by deſtroying either the one or the other, by the interpoſition of fire or fixed alcalies. In their diſſolution or corruption, all bodies loſe it; and where there is, as throughout the face of the creation, a continual diſſolution preparatory to a generation of ſucceding matter; no wonder, we find this principle, as we do,

flying

flying off from the earth, eſpecially where cumbuſtible matters moſt abound. Thus, fewel for fiery meteors, lightening and thunder is conſtantly ſupplied; thus waters are impregnated, as well as the air; and hence, other bodies are furniſhed with this material. In the animal and vegetable creations, it is not leſs manifeſt: It is continually flying off from them in the ſtate of nature, in ſome proportion; but, more, when they come to a ſtate of diſſolution, by fire, putrifaction and the like. This it is, that ſtrikes the ſenſe of ſmelling, variouſly from various bodies, in different modifications and ſtations. It is by this, that dogs and other beaſts trace and diſtinguiſh their prey or other bodies, by the ſmell alone. It may be looked upon as the ſpiritus rector of the whole terreſtrial creation, rather than the volatile vitriolic acid, which ſome look upon in that light, as before mentioned. It is moſt manifeſt to our ſenſes in the decompoſing of bodies; ſuch as are in a ſtate of combuſtion, fermentation or putrifaction. This principle, from thoſe eſcaping, ſtrikes our ſenſes with a diſagreeable ſtench; ſticks to the ſurface of plate ſilver and tarniſhes it firſt yellow and then black; firſt variegates the ſurface of bright lead, afterwards blews, and then blackens it; it gives a black or brown color to the precipitations of the ſolutions of either. It is this, that generates ſulphur, upon meeting with the univerſal acid in a ſubtiliſed ſtate; as by fuſing an alcaline ſalt neutrated with the vitriolic acid and a coaly or phlogiſtic body together. It is from the union of theſe two ſubtil bodies, in the vapor of the baths of Aken, that ſulphur is generated, not ſublimed, as is and has been long generally imagined. This it is, that in a manner revives the calces of lead, layed in paint upon boards or walls over jakes, ſewers, and where-ever putrifying bodies lye: For, there the whiteſt paint, with lead, grows black, or lead-colored, and ſoon after, puts on a ſhining metallic ſplendor, on its ſurface. It is probably this flying off in great abundance from fermenting and putri-

putrifying bodies, that renders the air too ſtrongly charged with it, noxious; as in wine cellars and brewers backs or tuns; where quantities of muſt or gile or wort are fermenting; or in vaults, where putrifying bodies are confined. It is this, that cauſes the ſubtil exhalations and vapors in mines and grottos, which are called damps, and are either combuſtible, as in the coal mines, particularly at Whitehaven; or ſuffocating, as in theſe and various other mines, as well as in the grotto, called Del Cani, and many others in Italy, and in the Alpes and Pyrinnees. And it is this, that was ſometimes found deſtructive, iſſuing from ſome clefts in the rocks about Carolſbadt, as obſerved by BERGER[a]; and it is probably the ſuperabundance of this, perhaps, complicated with ſomething arſenical, that renders the exhalations from ſeveral waters, ſuch as thoſe of the dead ſea are ſometimes ſayed to be, and ſuch as the rivers ACHERON, PHLEGETHON, and STYX, of the antient mythologiſts, from actual ſprings and rivers of this quality, were ſayed to be. But, to all theſe effects, the mercurial, always concommitant to the inflammable, principle, muſt undoubtedly contribute conſiderably.

§ 49. From this inflammable principle, we muſt carefully diſtinguiſh an oily matter, with which the air abounds, and from whence vegetables, if not animals, borrow ſome part of their oils, reſins and fat. From this, no water, that is long expoſed to the action of the air, is found free. It is confounded with the phlogiſton; but, moſt injudiciouſly; as they are as different, as a ſimple elementary matter and a mixed or compound body can be. The one is onely to be demonſtrated in its effects or unions with other bodies; the other may, by various means, be ſhewn in an aggregate form. Such waters, for example, as contain the former, loſe it upon being heated; whereas the later may be found with the reſiduum after evaporation of the aqueous humidity. The waters moſt ſtrongly charged

[a] Tract cited.

with

with this oily matter are moſt apt to ferment and putrify. Before one of theſe operations, or evoporation, the ſenſes can not diſcover this matter in any water. But, in the firſt, it gives an inflammable ſpirit, in the ſecond, a volatile acrid one, with phlogiſton; the original compoſition being diſſolved and a new combination produced, in fermentation; while it is broken and ſeparated into its firſt principles, in putrefaction; the laſt, evaporation, yielding the entire aggregate. In all putrid waters, the volatile phlogiſtic principle ſtrikes the noſe ſtrongeſt; and the ſtench produced, being likeſt that of a ſolution of ſulphur with alcalies, precipitated by acids, has univerſally obtained the name of ſulphur; though it evidently wants the principal part, the baſis of that mixed body, called Sulphur; and conſequently, every other characteriſtic of that mineral. Some, with aſſurance equal to their ignorance, hardily pronounce this oily matter, ſulphur; and the water, in which they find it, they call, and look upon as, ſulphureous, with abſurdity equally obvious; as ſhall be practically evinced and demonſtrated in the ſequel.

§ 50. As then it muſt appear, that waters may be moſt diverſly impregnated with one or more of theſe ſubtil matters in various proportions and degrees; ſo as to make an almoſt endleſs variety, eſpecially if we take in the various ſolid bodies, that may by theſe or other ſolvents be diſſolved and combined with them; it is eaſy to conceive how difficult it is to form a certain ſyſtem of mineral waters taking their denominations from their ſolvents, and what inextricable confuſion muſt be introduced by arranging the contrarieties of ſolvents and ſolvends to be found in the great diverſity of kinds of mineral waters, with which the earth abounds.

§ 51. Hence, leaving it to time and men of more leiſure, and more inventive geniuſes to form a more regular and perfect ſyſtem of nature in this branch of her exquiſite operations; I ſhall, in the ſequel, confine

fine myſelf to the ſimpleſt diſtinctions and the moſt familiar, that occur to me in the claſſing the waters, of which I purpoſe to treat, and that is, by giving every water a denomination from the principal ſaline or other terrene matter, with which it appears to the ſenſes, or by analyſis, to be moſt ſtrongly impregnated. But, as enough may not at preſent fall within my compaſs to complete this eſſay in the method propoſed, I ſhall point out the order and the diſtinctions, I think moſt eaſy, familiar and natural, and procede to claſs thoſe, I am to examine at preſent, in this order; as far as the number and diverſity of ſubjects will admit.

§ 52. 1. Firſt, mineral waters may be compriſed under two general heads; to wit, Cold and Hot.

§ 53. 2. After which, the moſt common, the moſt univerſal impregnation, that with ſalt, from which no mineral, and hardly any meteoric, water is found abſolutely free; may be regularly conſidered.

§ 54. 3. Then ſalt, or muriatic, waters; thoſe of ſprings, whether inodorous or fetid, and that of the ſea may be examined.

§ 55. 4. The next head may be ſaline waters of another kind; ſuch as, 1. Ammnoical waters, where that ſalt is generated; or, 2. nitrous or alcaline waters; as thoſe of Bonne, Seltz or Selter, &c. Theſe however may be neuter, or have a volatile acid predominant; and hence form other kinds; or with the fixed vitriolic acid a more permanent neuter ſalt, that of Glauber, may be produced, and conſtitute a 3. diſtinction of waters, of which we have great abundance in Britain; as Epſom, Scarborough, Cheltenham, &c.

§ 56. 5. Waters chiefly charged with abſorbent or calcarious earths, and with ſelenite; ſuch as incruſt veſſels in which they are contained, or bodies lying in their paſſages; or petrify bodies, or form by themſelves ſtoney concretions, Tophi, as they are called. Theſe may alſo be found like the preceding, either neuter, or with a volatile or fixed acid predominant.

§ 57.

§ 57. 6. Here, waters impregnated with bitumen or bituminous matters may be taken in. Of which, various kinds are found in ſprings or lakes in different parts of the world, as in different parts of Aſia and Africa, and in our American Iſles. Mention is made by ſome, of ſprings of this nature, as one at Neidelbadt in Switzerland, and ſome in our own country; but I have never ſeen any, that come under this denomination; except the brown water in Turbaries or Turf-pits, in ſome of our mountanes.

§ 58. 7. I can alſo conceive water impregnated with ſulphur by the means of alcaline ſalts or lime, about Volcanos: and believe there may be ſuch about Hecla, Aetna and Veſſuvius; but I have not ſeen ſuch, nor found them deſcribed by any. Certain I am, if there be ſuch ſolutions of ſulphur in water, they muſt appear more or leſs colored, and become milky and precipitate with acids; which has not yet been noted of any, that has fallen within my knowledge.

§ 59. 8. I can likewiſe conceive a water charged with modern nitre or ſalt petre; eſpecially in the crude ſtate, when the nitrous acid has but a calcarious earth to its baſe. But, as the generation of this ſalt is never known to be performed deeper, than within ſome eighteen or twenty inches of the ſurface of the earth; ſo we can not hope to find permanent ſprings equally charged with it.

§ 60. 9. We might expect waters impregnated with Borax; as well as with alum; but, I never yet ſaw ſufficient proof of either impregnation; though I have often heared of waters charged with the later.

§ 61. 10. We find almoſt every where waters impregnated with ſuch metals and metallics, as are ſoluble in the onely acid, which is found pure, in the earth; I mean diſengaged from ſome terrene or ſaline baſe, which muſt bar any acid from diſſolving any metal, except copper. Theſe may be called vitriolic waters. And may be of different kinds; firſt with reſpect to the two complete metals, and that metallic, or incomplete metal,

metal, that are found ſoluble in the univerſal acid. Theſe give us three different waters; as 1. one impregnated with copper; 2. one charged with iron, and 3. one charged with zinc. Which may alſo be diverſified according to the ſtate of the ſolvent. Thus, for example, we may have 1. a copper water by means of the fixed, and another by that of the volatile, vitriolic acid; 2. iron may afford two, and 3. zinc as many waters, impregnated upon the ſame principles[a].

§ 62. And theſe, with ſome ſlight variations, are the principal mineral waters, as yet known.

§ 63. The ſecond general claſs are the hot or thermal waters, commonly called Baths, which may undergo the like impregnations with the cold mineral waters. Theſe then may be either,

§ 64. 1. Simple and pure; as the waters of Pfeffer in Switzerland, Schlangenbadt, in Germany, and ſome others.

[a] Let the aſſertors of a volatile, vitriol, volatile iron or ſteel or other imaginary ſubtil chalybeate eſſences in waters, be undeceived by this truth; that there is no ferrugineous water as yet known, that loſes its iron tinging quality with galls, that does not ſtill retain the iron, not in a ſtate of ſolution, but precipitation; ſo as it may be demonſtrable to the ſenſes: Thus, for example, the waters of Pyrmont, Spa, Malmendy, Stavelot, Tunbridge, Scarborough, Cheltenham and Bath amit of their pellucidity and depoſite more or leſs of an ochrous earth, after they have loſſed the volatile ſpirit, in which, in the natural ſtate, it lay diſſolved. And upon adding a ſufficient quantity of the common vitriolic acid, to diſſolve this earth, not to predominate; the water will again become bright and give nearly the ſame tinge with galls, it did before. Which clearly ſhews, it is the ſolvent, not the ſolvend or ſolved, that is volatile. And to carry this matter ſtill farther; if the ſeparated ochrous earth be diſſolved in a ſufficient quantity of the common vitriolic acid; it will clearly evince the abſurdity of the notion and the term, Vitriolum volatile or Fugax, of which ſome men ſeem very fond, and the no leſs idle imaginations of ſome, who have not been hardy enough to commit their indigeſted thoughts to writing, but in converſation aſſert, that there is no real iron in any water: For, this ſolution will give common martial vitriol, as effectually as any ordinary, arteficial ſolution of that mettal.

§ 65. 2. Spirituous and active; as the Piſean, Tetuccinian and Nicarinian baths in Italy.

§ 66. 3. Muriatic; as the Pegaſacan of PLINY and AGRICOLA.

§ 67. 4. Alcaline; as the baths of Toeplitz.

§ 68. 5. Alcaline and muriatic; as the baths of Borſet, and Chaud-fontaine.

§ 69. 6. Alcaline and muriatic, with Phlogiſton; as the baths of Aken, and the inferior ſprings of Borſet.

§ 70. 7. Alcaline and calcarious; as thoſe of Bollerbadt near Wirtemberg.

§ 71. 8. Alcaline, calcarious and ferrugineous; as thoſe of Carolsbadt.

§ 72. 9. Calcarious, with a neuter and muriatic ſalt; as thoſe of Briſtol, &c.

§ 73. 10. Calcarious and ferrugineous, with a neuter and a muriatic ſalt, as thoſe of Bath.

§ 74. 11. Neutral baths, either,

§ 75. 1. Simple; or,

§ 76. 2. Ferrugineous; as the baths of Bade in Switzerland.

§ 77. There may poſſibly be other varieties of baths, as well as of cold mineral waters; but theſe, I take to compriſe the principal, that have yet fallen within the compaſs of my reading or obſervation, and more than I ſhall be able to explane in this tract. Therefore, as near as the want of ſufficient variety of ſubjects will admit, I purpoſe to attend to this order in the following eſſay.

SEC.

SECTION I.

Of SALT WATERS *in general.*

From a juſt ſenſe of Reſpect and Duty,
To that illuſtrious Hero,
That great Ornament to the Britiſh Flag,
Who, with invincible Valor,
And
Matchleſs Conduct,
Aſſerted and maintained
Britain's Dominion on the Main,
And
Bore her Terrors and Renown,
To the utmoſt limits of the Globe;
And now,
To the honor of his King,
And
The Happineſs of his Country,
With all Dignity, Prudence and Fortitude,
Fills the great, important Truſt,
Of
The firſt of the Lords Commiſſioners

For executing the Office
Of
Lord High Admiral of Great Britain;
Theſe Eſſays on Salt and Sea Waters
Are, with all due humility,
Inſcribed
To the Right Honorable
THE LORD ANSON.

§ 1. AS the ſubſtance, next to water, the moſt neceſſary to the well-being of his terreſtrial creatures, the alwiſe and provident creator has furniſhed all parts of his creation moſt plentifully with ſalt; in ſo much, that there is hardly any part of the known univerſe, in which ſalt, in greater or ſmaller quantities, is not found: There are no ſanguious animals known, whoſe juices are void of ſalt; moſt vegetables contain a portion of it; ſome, a conſiderable quantity. The earth, almoſt every where, abounds with it; ſo as to afford no ſpring, river or lake perfectly free from it; in ſome places to afford ſprings, rivers and lakes, as well as the univerſal ocean, which pervades or ſurrounds the whole globe, ſtrongly charged with it; and in many places to give entire quarries, mountanes of ſolid ſalt; whence, we cannot be at a loſs to deduce the origin of ſalt water. To theſe add, that ſalt is not confined to the terraqueous creation alone; for, the atmoſphere is often found more or leſs charged therewith; ſo that there is hardly any rain water found free from ſalt; and ſometimes ſalt, inſtead of freſh, water has been rained in different places; particularly here in Britain, as ſome report [a]. But, that may be otherwiſe accounted for in an iſland.

§ 2. Salt waters are as univerſally known by the ſenſes, as ſweet, or as the ſubſtance, with which the ſweet waters are impregnated to bring them under the appellation of ſalt.

§ 3. As there is hardly any water in a natural ſtate known, quite free from ſalt, and as the greateſt quantity of the waters of the globe, from their remarkably ſtrong impregnation with this mineral, have obtained the name of ſalt water; theſe naturally firſt preſent themſelves to our conſideration, in an eſſay on mineral waters.

§ 4. Theſe, like the common ſweet waters, fall under our obſervation in ſprings, rivers and lakes, as well as in that common receptacle the ſea, to which all the waters of the earth, however ſimple or impregnated, bend their courſes.

§ 5. Naturaliſts, antient and modern, furniſh us with numberleſs hiſtories of ſalt ſprings, either hot or cold.

§ 6. PLINY [a] and AGRICOLA [b] mention the Pegaſaean and other hot ſprings, from the evaporation of which, ſalt was made. The former and ARISTOTLE [c] both ſpeak of a ſalt fountane in Chaonia, a part of Epirus, in Greece. AGRICOLA [d] and POMPONIUS MELA [e] give an account of a ſpring, called Salſula, in the province of France, called Narbonne; which is found ſalter, than the Mediterranean ſea. Of this kind, there are great numbers in different parts of Germany, Italy, Poland, Ruſſia, Sweden, &c. Wherever there are any conſiderable ſprings of this nature in Germany, the place is diſtinguiſhed by the name of Hal or Hala, probably from the greek name, Ἅλς, for ſalt. Such ſprings have given riſe, as well as names, to many towns in the empire; ſuch as Hala Hermundurorum, Hala Sueviae, Hala Rhetia, Hala Magdeburgica,

[a] Nat. hiſt. l. xxxi. c. vii. [b] De Remetallic. l. xii. p. 448. [c] Meteor. l. ii. ſum. 1. c. 3. [d] De natur. eorum, quae effluunt ex terra. l. 1. p. 94, 95. [e] De ſitu orbis, l. ii. c. 5.

Hala Saxonum, and many others of inferior note. Of all the now known ſalt ſprings, HOFFMAN reckons that of Luneburg to yield the beſt ſalt. Theſe laſt are not, that I can learn, living ſprings, they are pits or wells of different depths, out of which water is drawn by means of pumps or other machines. As ſuch as theſe were probably always found moſt common; ſo it is likely they were the firſt of this kind uſed for the purpoſe of ſalt making.

§ 7. PLINY [a] tells us, that in Babylon they extracted oil for their lamps, and ſalt for their ordinary purpoſes, from ſuch ſprings or wells. After having evaporated a conſiderable quantity of the water, the oil or bitumen was by ſcumming collected from the ſurface; while the ſalt was found at bottom. From him, we alſo learn, that ſalt was alſo made in Cappadocia from ſalt wells in the like manner. As we alſo do from AGRICOLA [b], that ſuch like wells were found and uſed for the ſame purpoſes here, as well as in Spain and Italy.

§ 8. The ſame authors likewiſe mention ſalt rivers; as one in Spain obſerved by STRABO, one in Licilia, obſerved by VITRUVIUS; one in Caria, where the temple of Neptune ſtood; ſeveral about the Caſpian ports, about the country of the Mardi, in Armenia and other parts of Aſia; particularly the Ochus and Oxus of antient Bactra, now Uſbeck, and one not far from the mouth of the Euphrates.

§ 9. From the ſame authority we learn, that there are many lakes, as well as rivers, wells and ſprings of ſalt water in divers parts of the world; from whence ſalt is in like manner extracted. The chief of theſe are, the Tragaſaean lake in Aſia the leſſer, and thoſe of Phrygia, that particularly, called Tatta; thoſe of Cappadocia and Pamphilia; and the greateſt known, that called Mantianus in Armenia; that in Cyprus,

[a] Book and chap. laſt cited. [b] De natur. eorum quae effluunt ex terra.

upon

upon the ſouthern coaſt, near Cittium; in Judaea, the lake Aſphaltus or the lake of Sodom; as well as two very great ones near Uſbeck; in Ægypt the celebrated ſalt lake near Memphis; and near Babylon, that, called Thopetis, into which the river Tygris diſimbogues itſelf; and many found in different parts of Africa, as in that, anciently called Cyrenaica, now Bara, not far from the place, where the temple of Jupiter Ammon ſtood; with which, ſome about the Palus Maeotica may be enumerated.

§ 10. We have likewiſe ſalt lakes nearer home; as in Germany, a remarkable one, mentioned by the ſame AGRICOLA, between Stappel and Seburg; which, though bordering upon a lake of freſh water, is notwithſtanding, as ſalt as the ſea. There is one in Apulia in Italy, called Tarentinus; and three in Sicily; one called Cocanicus, another Agrigentinus, and a third, near Gala. There are many others in different parts of the world; but, theſe are enough for the preſent purpoſe. Such as are curious to ſee a farther recital are referred to PLINY, nat. hiſt. GALEN, de ſimp. medic. facult. lib. xi. c. de ſale. AGRICOLA de nat. foſſil. MATHIOLUS, in DIOSCORID. lib. v.

§ 11. In Britain, we have many ſprings and wells richly charged with ſalt; but, neither rivers nor lakes, in which it predominates. Hence, we ſee, that many waters are, in various parts of the world, found as ſtrongly impregnated with ſalt as the ſea, or great ocean, that environs the globe, and is every where found more or leſs ſalt.

§ 12. If it be enquired, whence theſe waters derive their ſaltneſs, a queſtion, which has engaged better heads and pens than mine; I ſhall anſwer, when I am reſolved, whence the immenſe quantity of foſſil or mineral ſalt, found almoſt every where, derives its origine. When we find a ſalt, or any ſuch like ſubſtance, in a water, which we cannot diſcover in the earth, we may endeavor to account for its generation in the water, or by ſome treatment given it.

But, if we find a ſalt plentifully in nature, and find waters, that waſh this ſalt impregnated with it; how much farther are we to ſearch for the cauſe of this impregnation?

§ 13. We find then, ſalt diſperſed throughout the univerſal creation: It muſt therefore be hard, if poſſible, to get water free from it. But, if we find, that, in ſome places, there are immenſe rocks, mountanes of foſſil ſalt, which ſalt is one of the moſt ſoluble in water; it can not then be difficult to conceive how waters, coming into contact with ſuch ſalt, ſhould be, as theſe ſprings, wells, rivers, lakes and the univerſal ocean are obſerved, therewith impregnated.

§ 14. PLINY[a] then, tells us, that ſalt is dug up in Cappadocia, in large ſquare pieces, clear, like ſpar, ſelenite or Muſcovy-glaſs. The ſame is obſerved by METHIOLUS[b], as well as by GALEN, AGRICOLA and others. Theſe authors inform us not onely of quarries, or mines, but of whole mountanes of this ſalt in different parts of the world. Among theſe, is the mountain in India, called Oromenus by PLINY; where ſalt is taken up as ſtones out of a quarry, and in ſuch plenty, as to bring into the king's coffers a revenue ſurpaſſing what may be drawn from gold and pearl. The houſes and walls of Carrhis a city of Arabia, and after her example, thoſe in other parts of Arabia and Ægypt, were built with glebes or rocks of ſalt cemented only with water, to ſupply the place of ſtone and mortar. The like plenty of this ſort of ſalt is ſayed to be found in Spain and in Africa.

§ 15. Many other writers give us ſuch accounts, but none more particularly than AGRICOLA[c]. There are, ſays this illuſtrious natural hiſtorian, many and great mountanes of ſalt in divers parts of this globe. MATHIOLUS tells us of ſalt dug up in Calabria, particularly in the mountain called, Altomante, in

[a] In the laſt cited book and chapter. [b] In the laſt cited book and chapter. [c] De natur. foſſil. lib. iii. et de ſale caedua et foſſili.

great

great quantity, and as clear and pellucid as cryſtal. In Germany near Seburg, where the ſalt lake before mentioned is found, and about the Caſpian ports, there are huge rocks of this ſalt, which are not dug up, as the water is found ſo impregnated with it, as to ſerve all the purpoſes of ſalt. It is dug up in many other places in Germany, as about Sibenburg, Salzeburg, Torrenburg, Acterhell, Tyroll, &c. Alſo in Poland, in various parts, as at Bochnia, Veliſke and Cracow, in particular; in Sweden; in the mountanes of Hungary; in Ruſſia, Siberia and Tartary. The mountanes of France and Spain abound with foſſil ſalt, and we have plenty of it in many counties of Britain; particularly, thoſe of Worceſter, Stafford, Cheſter, Lancaſter, &c.

§ 16. When ſuch immenſe quantities of this ſalt are diſcovered, we may reaſonably conclude, there are greater funds of it, that lye as yet undiſcovered; except by their effects. Whence, it is more to be wondered, that we have ſo much freſh water left as we find, than that there are ſo many ſprings, wells, rivers, lakes and the univerſal ocean, ſo replete with this very ſoluble ſalt, as are obſerved.

§ 17. This ſalt is known in general by the appellations of ſal foſſilis, or mineralis, terrenus, montanus, caeduus, gemmeus, &c. by the naturaliſts. It is of different colors and conſiſtencies according to the different ſubjects, with which it is united; and obtains the name of gem, onely when it is pure and pellucid. This mineral ſalt has one remarkable property, obſerved by WALLERIUS, but not eaſily accounted for, clearly; that is, that ſoon after a piece of the ſalt mine has been expoſed to the air; it ſo far increaſes in weight, that the laborer, who carried it with eaſe in the mine, is found hardly able to move it after. If this be an increaſe of ſalt, as is moſt likely; we ſee how ſudden the generation of it is to ſupply the conſumption of it made throughout the creation. Hence, we need not be ſurpriſed, that our funds of

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it are not to be exhauſted by all our waters. And, as all the ſalt furniſhed to our kitchens or tables, or for the various purpoſes of medicine or arts, is derived from ſome impregnations or ſolutions of this kind; we may eaſily conceive the variety of this ſalt, which from the various modes of operation muſt neceſſarily ariſe.

§ 18. When any pure ſolutions of this rock or foſſil ſalt, whether natural or arteficial, ſuch as the waters of ſalt ſprings, rivers or lakes, or of the ſea, are evaporated in fit, clean veſſels to cryſtaliſe, they yield firſt an earthy matter, which being ſeparated by clarification, they afford pure pyramidal cryſtals of a white or colorleſs ſalt, ſuch as we here in Britain uſe for all purpoſes. But, where ſalt waters are evaporated to a dryneſs, without clarification, or ſet in ſhallow ponds or marſhes to evaporate in the open air; there we ſhall have a foul, gray, brown or aſh colored ſalt; what we call Bay-ſalt, from the adherent, as well as acquired, earth; ſuch as is chiefly uſed in France and other inſlaved countries. Where, on account of the heavy gabel or exciſe layed upon this neceſſary article, and the penalties inflicted to enforce the ſevere exaction; no man dares to purify ſalt for his own table, nor conſume leſs, than the monarch's officer thinks fit. Curſes, which all our corruptions, in morals, religion and politics, have not yet been able to bring upon Britain.

SECTION II.

Of SALT SPRINGS.

§ 19. A Remarkable inſtance of the natural happineſs of our country, appears in this; that though as an iſland, it is on every ſide ſurrounded with the ſea, which extends its dominion, with its commerce, to the remoteſt branches of the ocean, and of courſe, furniſh-

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es its coaſts with plenty of ſalt; yet, has indulgent providence ſupplied the parts moſt remote from the ſea, with ſome of the richeſt and beſt ſprings of ſalt water, known in Europe.

§ 20. In the philoſophical [a] tranſactions of our Royal Society, we have a remarkable account of a ſalt ſpring, which riſes at ſalt-water-Haugh, near Butterby, about a mile and an half from the city of Durham, in the middle of the river Weare. This ſalt water bubbles up equally in all parts of the channel of the river for fourty yards in length and about ten in breadth. But, the ſalteſt ſpring, which is, in mine apprehenſion, onely that, that appears leſt diluted with the river water; iſſues out of the middle of a rock, in the river, which is leſs ſubject to be overflowed by the freſh water. Theſe ſprings render the whole river below them brackiſh for above an hundred yards.

§ 21. We have various other ſalt ſprings in different parts of the country. Moſt of which, if not all, that I know of, are found at or near a place, whoſe name terminates in wich or wych, as Nantwich, Middlewich, Northwich, Droitwich, Upwich, Netherwich, &c. &c. &c. As if the word, wich, related to ſalt ſprings or ſalt-pits; for, moſt of them are pits or wells. I find the houſes, in which the ſalt works are carried on, are called alſo wich-houſes; which makes me imagine, that wich, in ſome of the gothic languages, that compoſe our vulgar tongue, implies a ſalt-work or ſalt-houſe, and that the names of all the places terminating in this word, aroſe from the ſalt-pits or ſprings, or ſalt-works of one kind or other [b]. Theſe work-houſes are alſo called Seals; which I take to be a corruption of the word, which ſhould be written, Sales, from the Latin word Sal, as the german Hal or Hala ſeems to be from the greek Ἅλς, Salt.

§ 22.

[a] N° 163, p. 726.

[b] I can not agree with our learned antiquary, Mr. VERSTEGAN, who. in his Reſtitution of decayed intelligence in antiquities, to me ſeems to confound the terminations wic and wyk with wich or wych, without any known authority or propriety: In p. 297.

§ 22. In the ſame [a] philoſophical tranſactions, we have as particular accounts of our mediterranean ſalt-ſprings or pits, and the manner of working them, as our fund of knowledge in chemiſtry could, in thoſe days, admit; which does not appear by any of thoſe, that examined them to have been very great; ſince none of theſe writers, not Dr. [b] PLOTT, nor even our great [c] LISTER, knew how to account for the terrene parts, which ſeparate in the evaporation of theſe waters; which the former ſeems to have looked upon, as a formation of ſand; nor for the ſulphureous ſtench iſſuing from them; eſpecially when the pits are not frequently pumped.

§ 23. As it is very rare to find a mineral water ſimply charged with one ingredient; ſo we ſeldom or never find a ſalt ſpring, that is, a ſimple ſolution of pure mineral ſalt.

§ 24. Moſt of theſe kinds of ſprings are found in Fens or Moraſſes, in or near Moſſes or Bogs, which are a congeries of diſſolved vegetables, and by or in rivers, or rivulets or other currents or lakes of ſweet waters. Hence, it is eaſy to conceive how theſe may imbibe an oily matter, even before they are much expoſed to the open air.

§ 25. It is then no wonder, theſe like ſprings ſhould be found, as they often are, eſpecially where they are not conſtantly drawn, putrid and ſtinking; thus moſt of our ſalt or brine-pits, as they are called, are, and have been obſerved to be, ſince the time of LISTER. Hence, we ſee, that ſalt is not, in this inſtance, as is generally imagined, an effectual preſervative from putrefaction. Proofs of this, we have alſo

297, 298, he tells us, that wic or wyk, in our antient language, implied a place of refuge or retreat. And then ſays, that theſe terminations were corrupted by the Norman invaſion into wich or wych; of which he offers no proof.

[a] N° 53. p. 1060. N° 55. p. 1122. N° 54 p. 1077. N° 142. p. 159. N° 156. p. 489.

[b] N° 145. p. 95. [c] N° 156. p. 489.

alſo in the Bilge-water of ſhips; as the water, that ouzes through the pores or joints of the wood and lyes in the hold is called. Moreover, our ſea coaſts every where give demonſtrative evidence of this truth: There, we often ſee pools, that have been filled by ſpring tides with ſea water and ſome weeds. Theſe, in the ſummer-time eſpecially, never fail of putrifying ſo, before the next ſpring-tides renew them, that they ſtink, like the bilge-water of ſhips, or the ſtrongeſt ſolution of ſulphur precipitating with an acid; while the weeds, ſtones, banks and bottom of the pool are covered over with a whitiſh, ſmooth, mucilaginous, or down-like ſubſtance, which I take to be a minute conferva.

§ 26. Hence, we may ſee how idle a notion it is to attribute this ſmell to ſulphur; or to call any water ſulphureous, merely for having the inflammable principle thus ſet at liberty, and ſhewing itſelf to the ſenſes and by its natural properties and effects. All putrid bodies, in a fluid as well as a ſolid ſtate, produce the like effect. And from any thing, that has as yet occurred to me, I ſee no reaſon to believe or even to ſuſpect, that any cold water, in Britain, Ireland or elſewhere, thus charged with the ſmell and properties of this phlogiſton, is truly ſulphureous, or derives this principle from any other cauſe, than putrefaction. I am the more induced to take up this opinion, becauſe the learned and ingenious LISTER looks upon all the waters in his time known in Yorkſhire, inconſiſtently called ſulphureous, and abſurdly, Spaws; as ſo many ſalt or brine-pits, which might be rendered pure and ſweet-ſmelling, as any other ſprings or brine-pits by frequent drawing. This is further evinced by a vulgar remark; that the ſtench of all the waters of this claſs, like thoſe of common ſewers, is always increaſed in cloſe, ſultry, wet weather and at the approach of ſuch changes, which, in all bodies, are found to promote putrefaction. So that we are nicely to diſtinguiſh between waters of this kind and natural baths with

with this or the like ſmell: For, though phlogiſton, as a ſimple elementary matter, muſt be one and the ſame thing, from whatſoever part of the creation it may be produced; ſome allowance is to be made for the difference of the bodies, whence it comes into the waters; ſince from putrefied vegetables and animals, it can never carry with it any of the fixed or volatile vitriolic acid; conſequently, may promote, not prevent, putrefaction, but can never generate ſulphur; whereas, it can hardly fly off from mineral bodies, eſpecially from ſulphur, coal, and pyrite, which moſt commonly yield it, without ſome of this acid; by an apt union with which, ſulphur may, as it never can otherwiſe, be generated, and by which, putrefaction muſt be impeded or prevented.

§ 27. That this ſmell ariſes onely from this ſubtil volatile principle, is plane from its flying off in evaporation, without leaving any veſtige in the ſalt or terrene reſiduum, upon evaporating ſuch waters, as are thus putrefied or impregnated with it. This inflammable principle then, is not an eſſential, it makes but an accidental, part of the compoſition of our ſalt ſprings: For, though all [a] have it, eſpecially upon lying ſtagnant; few or none have it perceptibly, that are well drawn [b]. And even the Yorkſhire putrid waters give no appearance of it in the reſiduum after evaporation.

§ 28. Some ſalt ſprings are but mere ſolutions of mineral ſalt; as the upper pit at Droitwich ſeems to be, by LISTER's account; whileſt others carry different mineral taints with them; ſuch as calcarious earth and ſome iron; as thoſe of Northwich in the county of Cheſter are by the ſame author and others obſerved.

§ 29. I find none however ſo perfectly pure, as not to yield ſome earth in evaporation. This is what

[a] Northwich, Weſton, near Stefford, Netherwich at Droitwich, &c.

[b] Upper pit at Droitwich, &c.

Doctor

Doctor PLOTT took to be a formation of ſand, and attempted to ſeparate, by ſtraining the water acurately before boiling up. But, this famed naturaliſt was miſtaken: There probably are two cauſes for this ſeparation of earth. 1. If by means of a volatile acid, theſe waters be impregnated with any metallic or other earth, as ſoon as that ſubtil ſolvent eſcapes, as it muſt by expoſing the liquor to heat or to the open air; the combination muſt neceſſarily be broken; the reſult of which muſt be, in proportion to the diſſipation of the volatile acid, the terrene parts muſt ſeperate and ſubſide. And thus we find it: For, upon committing any of our ſalt ſpring waters to evaporation; the martial earth, firſt ſeparates and ſubſides; and then before any ſalt appears, a terrene pellicle floats upon the brine and partly ſubſiding, coats the ſides and bottom of the veſſel in which it is boiled, and obſtructs the granulation or cryſtalliſation of the ſalt. To ſeparate this, ſome uſe ſand-pans; which are ſhallow pans of thin plates of iron of the ſize of the ſalt-pans, and perforated with many ſmall holes; theſe are ſet at the bottom of the liquor, till this ſand-like earth ſeparates, that by raiſing them this extraneous matter may be taken away. It is partly to forward this operation, and partly to inviſcate and carry off other foulneſſes, that ſome throw in a certain portion of blood or whites of eggs in order to clarify the brine: For, theſe by their viſcidity, intangling any thing ſuſpended in the brine, and then by boiling, hardening, retain it; and ſo floating on the ſurface, are all together ſcummed off and rejected. Then, the evaporation being purſued, the ſalt ſhews itſelf in an ice-like pellicle, from which inverted pyramids grow pendent; this pellicle breaking falls to the bottom; whence it may be gathered with rakes, taken out, ſet apart and dried, and ſo the operation continued, till nothing but a yellow, oleagenous ley of the conſiſtence of a ſirup remanes, which will yield no more concrete ſalt. 2. The ſecond cauſe, that concurs in occaſioning the terrene

ſepara-

ſeparation in evaporating the brine, is a decompoſition of the ſalt itſelf, which is thus partly reduced to its firſt principles, the ſpecific acid and the mineral alcali; the firſt of which is partly evaporated, as appears in the water deſtilled, and partly deſtroyed; whence the terrene parts become ſenſible and no longer ſoluble in the brine. The ſtronger the fire, the more ſalt is thus decompoſed. Whence, ſome have vanely imagined it volatiliſed. To avoid this loſs however, as much as may be, the evaporation ſhould be ſlow and gentle. But, be it managed as it may, there will be ſome decompoſition, though it be of the acid itſelf, which conſiſts of the aqueous and fixed terrene principles.

§ 30. Hence, we ſee, our briny ſprings ſometimes contain a three-fold earth, 1. a martial or otherwiſe metallic; 2. a calcarious; 3. an alcaline, earth. In ſome, the firſt is not perceptible. In others, but little of the ſecond appears. But, there is none without the third. And all ſalt, even the pureſt, may, by frequent ſolutions and evaporations, be entirely decompoſed.

§ 31. From theſe obſervations, we learn, that, beſides the ſpecific acid, which, with an alcaline baſe, conſtitutes ſea ſalt, there is alſo another and a more ſubtil acid in our brine pits; which is probably the volatile acid of vitriol, and which flying off firſt, lets the iron, in ſuch as tinge black with galls, firſt ſubſide. The effects of this acid in its eſcape are perceived by the workmen, who find it ſometimes affect their noſtrils and lungs, and make them ſweat extremely; if they ſtand much over it. It likewiſe corrodes all the iron, that comes within its reach. Yet, upon the whole, the workmen are found generally healthy and long-lived.

§ 32. The next product of this proceſs is the ſea ſalt itſelf; whoſe component parts, diſtinguiſhing characteriſtics and principal properties have been briefly ſet forth in the idea of ſalts[a]. The ſlower the evaporation,

[a] § 37, 55, 63, 64, 70, 77, 81.

poration, the greater the quantity of ſalt, and the larger and more diſtinct cryſtals are obtained. The brine-pit at Nantwich yields about a ſeventh part of ſalt; that at Middlewich one fourth; the ſtrongeſt at Droitwich, ſix ounces in the pint; the ordinary four.

§ 33. The laſt product of our ſalt ſprings, that falls under our conſideration, is the heavy, oleaginous liquor, that affords no more concrete ſalt by evaporation. This is the mater ſalis, the mother of ſalt, of ſome writers; the oleum calcis, oil of lime, of others; the ſal ammoniacum fixum, of POTT and others; the lixivium a coctione ſalis communis relictum, the ſalt ley, of HUFFMAN; in our language, bittern.

§ 34. This hardly parts with its humidity; and being evaporated to dryneſs, very ſoon imbibes new moiſture enough to bring it to its former liquid conſiſtency. The more fire is given it, the ſooner and more moiſture it will abſorb, and the more liquid it will run. Before it abſorbs the humidity of the air, this maſs, upon percuſion or hard friction, appears luminous in the dark; as mercury upon agitation in a glaſs tube does. So that it enters the claſs of phoſphorus.

§ 35. This is the ſpecific acid of ſea ſalt, ſo firmly attached to a terrene, inſtead of a ſaline and lixivial, baſe, that the union is not to be broken by any degree of fire, or by any other means, without interpoſing ſome body, that has a ſtronger attraction to this acid or this earth, than either of them has to the other. Thus, a fixed alcali unites with the acid, gives a muriatic ſalt and precipitates the earth; and the vitriolic acid wreſts the earth from the muriatic; and uniting with it, forms a ſelenite; as by ſucceeding experiments will appear.

§ 36. Where this acid is perfectly ſaturated with a pure mineral, as well as a vegetable alcali, there no ſeparation of earthy parts, upon due evaporation, will appear; no mother or ley of ſalt will remane. But, theſe like impregnations are very rare in nature: For,

as the acid is ordinarily generated in the bowels of the earth; it is odds, it meets firſt with, and firſt attracts and is attracted by, ſome calcarious earth, to which it will adhere, till an alcaline ſalt attracting, and being more ſtrongly attracted by, the acid, uſurps its place. But, where there is not enough of ſuch alcaline ſalt, the calcarious earth and the alcali, now charged with the acid, will remane together ſuſpended, when diſſolved in water; till upon exhaling the humidity to a certain pitch, the neuter muriatic ſalt will run into a cryſtaline concrete; leaving that part, which was charged with the calcarious earth in this oleagenous ley.

§ 37. That this theory is juſt will appear from this, among other following experiments; let any quantity of the acid of ſea ſalt be ſaturated perfectly with lime or chalk; or let the reſiduum after deſtillation of ſalt ammoniac with quick lime, which is the ſame thing with the quack medicine, called the liquid ſhell, made by injudiciouſly calcining any ſhells and ſalt ammoniac together, to the loſs of the volatile parts; theſe before they abſorb humidity from the air, give a kind of phoſphorus, commonly called, from him that is ſayed to have firſt obſerved it, HOMBERG'S; but, expoſed to a moiſt air, ſoon attract the humidity and run into a ley, like the bittern or ſaturated acid of ſalt, to all intents and purpoſes; except the color; for, the one is yellow; the other colorleſs. Any of theſe, evaporated to a dryneſs, will preſently after contract new moiſture, and in time run quite as liquid as before, and give an acrid, alcali-like, bitteriſh taſte.

§ 38. Hence, it is eaſy to ſee, why ſome ſalt is very apt to run, ſo as hardly to keep a dry form. This is owing to the quantity of this calcarious ſalt, that is contained in the water. Some attribute this deliqueſcency of ſalt to the redundance of an alcali. But, this miſtake will appear by conſidering, what happens in the following experiments.

§ 39. If to this ſalt ley, ſufficiently diluted, any fixed alcaline ley be added; it immediately becomes milky and turbid, and a fair white magiſtery ſubſides. If the alcaline ley be added, till it cauſes no further milkineſs or ſeparation in the mixture, and it be then filtrated; a ſubtil white abſorbent earth will be found in the coffin, equal to that which is called, Magneſia alba; being the ſame as when obtained from the like mother or ley of nitre by the ſame proceſs. The liquor, from which this earth was thus ſeparated, by the ſtronger attraction of the acid with the alcali, than with the abſorbent earth, has received a new impregnation; it now becomes ſaturated with the alcali; which gives a ſalt in all reſpects like the beſt common ſalt, ſtanding all the changes of weather, without abſorbing any extraordinary humidity. This partly explanes the compoſition of ſea ſalt, as well as of this calcarious ſalt or bittern. Might not this hint be applied to good purpoſe in our ſalt works, in which the brine may well be purified with pot-aſhes or any other alcaline ley, before boiling up?

§ 40. Of this we have further proof by another experiment: If to one part of this ſalt ley, three parts of putrified urine be added, a ſimilar precipitation with the foregoing, but not ſo complete, is produced. If then it be ſtrained and evaporated to dryneſs, it will no longer give a ſaline ſubſtance, ſtanding hardily the utmoſt force of fire, as before; for, now, it will be ſemivolatile, and ſubline by a much ſlighter heat: For, here, the volatile alcali in the urine, as the fixed in the preceding experiment, uniting with the mineral acid; like that, partly precipitates the earth, and forms that ſemivolatile concrete, which, by its generation, as well as analyſis, appears to conſiſt of the acid of ſalt and a volatile alcali united; and this is ſalt ammoniac.

§ 41. Theſe two experiments ſhew two ſalts, with which this acid in this ſalt ley has a ſtronger attraction, than with its terrene baſe. But, in order to give

a ſtill clearer idea of the compoſition; let us ſhew ſuch bodies, as have a ſtronger attraction with the terrene baſe, than with the acid. This, all acids, heavier than the acid of ſalt, have. Theſe are, the acids of nitre and vitriol. The former enters the compoſition and diſſolves it, expels the muriatic acid, and uſurping its place, unites with the fine abſorbent earth, and forms crude or immature nitre. The heavy acid of vitriol, enters the compoſition with violence and efferveſcence, expelling more powerfully and viſibly the muriatic acid, in ſubtil, white vapors; at the ſame time, cauſing a ſeeming precipitation in the liquor, which is properly a cryſtaliſation, in the production of that inſoluble ſalt like ſubſtance, called a Selenite; which ariſes upon the union of a vitriolic acid with an abſorbent earth. Thus, the truth of the theory of this compoſition is fairly proved, on either ſide the queſtion.

§ 42. But, this ley attracts, with humidity, an acid from the atmoſphere, with which it forms a ſalt, which runs into priſmatic cryſtals, ſtill apt to become deliqueſcent or grow moiſt in the air, and give a bitter taſte. Thus, if this be highly evaporated, that is, to the appearance of a thick pellicle on the ſurface, and then layed in a dry open place, in a certain time, a great part of it will be found ſhot into cryſtals, not pyramidal or cubical, but priſmatic. Theſe being ſeparated from the remaning ley, are at ſome of our ſalt works, again diſſolved and cryſtaliſed, to produce that common bitter purging ſalt, which from ſome reſemblance to the ſalt firſt extracted from a mineral water here in Britain, obtained the name of Epſom Salt.

§ 43. Hence, we find the ſubtil acid of the air capable of inſinuating itſelf into this kind of ley, and of forming there a purging, bitter ſalt, which bears great analogy to the ſalt of all our purging ſprings, and helps us to account how ſuch ſalts are produced. This kind of ſalt may be obtained in larger cryſtals, by

by the addition of alum or of the reſiduum after the deſtillation of green vitriol, and for the ſame reaſon with the preceding. This bitter ſalt bears ſtill ſome relation to ſalt, 1. in its ſolubility; 2. In its giving ſome marks of the muriatic acid, with ebullition, upon mixture with the concentrated vitriolic acid; 3. In its precipitating ſilver; 4. In its yielding a kind of magneſia alba by precipitation with fixed alcalies. Its affinity to Glauber's ſalt appears, 1. from the figure of its cryſtals; 2. from its taſte; 3. from its fuſibility; 4. from its generating ſulphur upon fuſion with charcoal or any phlogiſtic body, and ſolution and precipitation with any acid.

§ 44. It is obſervable, that in all this, no traces of nitre are ſeen; nothing of ſulphur or bitumen appears, more than the oily matter, which is found more or leſs in every water, as appears by the examen of the waters of London. However, this inconſiderable portion helps to impede the cryſtalliſation of ſome of the muriatic ſalt contained in the brine; ſo that, with the abſorbent earth, there is always more or leſs of the mineral alcali in this ſalt ley, which tends to the giving the neuter priſmatic ſalt with the vitriolic acid in any form. The yellow color of this ley is derived from the oily matter imbibed from the air. This appears by the color's being deſtroyed by evaporating the ley to a dryneſs, calcining the reſiduum, and letting it again run in the air.

§ 45. From theſe experiments and obſervations, we may conclude, that our ſalt ſprings or wells, or brine-pits contain like other waters, 1. an oily matter, which by putrefaction, upon long ſtagnation, gives a fetid phlogiſton; 2. more or leſs of a volatile acid, by whoſe means principally, iron is diſſolved in the water, and, upon this acid's eſcaping, ſubſides; 3. A calcarious earth in greater or leſs abundance, according as it meets with more or leſs of the mineral alcali; and, 4. A ſalt, compoſed of the vitriolic acid ſubtiliſed by the mercurial principle, which conſtitutes the ſpecific muriatic acid, and the mineral

alcali; all diſſolved in a certain quantity of ſimple water. The ſtronger the impregnation, the leſs terrene parts and the leſs priſmatic ſalt; thus, in Droitwich brine-pits, little or none earth ſeparates, and no bittern is found.

§ 46. Hence, we may judge of the uſes and virtues of theſe like impregnations. But, we ſhall not further expatiate upon theſe uſes, till we come to conſider, what naturally preſents itſelf to our conſideration in the ſame point of view;

SECTION III.

The SEA WATER.

§ 47. AS the ſea is the common receptacle, to which all the waters of the globe, ſimple or diverſly impregnated as they may be, bend their courſes; it muſt be ſuppoſed with the common predominant impregnation ſalt, to be charged with an infinite variety of other bodies; not onely from what ſprings and rivers waſh into it from the land; and what ſhipping contribute; but from what it derives from the boundleſs tracts of land it covers or waſhes, and the endleſs number and diverſity of vegetables and animals, that derive their being and ſubſiſtence from this immenſe maſs of mineral water; and, in their turns, impregnate it with their recrements, excrements, &c.

§ 48. The inexpreſſible miſchief, not onely to the inhabitants and products of the ſea, but to thoſe of all the reſt of the globe, which muſt have aroſe in the ordinary courſe of nature from the ſtagnation of this immenſe maſs of water, is prevented by the ineffable wiſdom of the great author of nature; not, as ſome have imagined, by making it ſalt, which could onely retard, not obſtruct, putrefaction[a]; but, by keeping it in conſtant rapid motion in all its parts; by the admiſſion of the currents of numbers of great ſprings and rivers into it in ſome places, and eſpecially by the conſtant and uniform agitation of it by the tides,

[a] § 24, 25, 26.

which

which move it in two different directions four times in the natural day. By which, the greateſt parts of it are put into violent agitations and moſt others into more or leſs; ſo that it can no where be looked upon as ſtagnant.

§ 49. From the firſt view of this great maſs of waters, it is natural to conceive it, as it muſt be confeſſed, moſt complicated. But, when we conſider its immenſity, how few of the bodies we ſee mix with it, unite and make a part of the water, what a proportion theſe bear to the quantity of water, and above all, how the admixture of one may cauſe the ſeparation of one or more other bodies; we ſhall not be ſurpriſed at finding the waters of the ſea more ſimple or leſs compounded, than is by the generality imagined.

§ 50. In the earlieſt and pureſt ages of the healing art, when phyſicians were ſo far from being affected with the fear of tranſgreſſing, or the reproach of complying with, little prevaling modes, in prefcribing ſimples within the knowledge of the vulgar; and when even the well-known ſimplicity was no ſmall recommendation of any medicine to practice; the ſea water was onely looked upon as a ſimple, natural ſolution of mineral ſalt, and as ſuch preſcribed and applied. But, as the art became debaſed with empiriciſm, the knowledge and uſe of ſimples became neglected, and no cure was looked for, but by the means of ſome enormous, pompous compoſition. Hence, notwithſtanding the many and great lights, by modern diſcoveries reflected upon the art, empiriciſm ſometimes raiſes its ſtubborn head, and will not permit the practicioners, under its full influence, to attribute the cures wrought by ſimples or plane natural mixtures to ſuch; but, bids him aſcribe theſe ſalutary effects to ſome extraordinary, unaccountable compoſition. Hence, ſome give ingredients to waters, which are in themſelves of the moſt ſimple. Thus, ſince the revolution of phyſical faſhions has revived the antient uſe of ſea

water among us, we are not to look for the natural effects of ſuch an impregnation, as it is by convincing experiments found; but, blind empiriciſm bids us add, what nature has not, and make the ſea water about our coaſts a compoſition of ſea ſalt, bitumen, niter, and an unctuous matter; and, without any juſt enquiry, but taking the matter implicitly for granted, inſtitutes a practice ſo irregular and erroneous, as can not long hold its ground, but muſt make way for the next mode that is introduced.

§ 51. Rational and free agents ſhould think and judge for themſelves. Fetters or confinements of the body or its limbs are deteſtable to the brute creation. Reſtraints or impoſitions on the nobler parts, the mind or its functions, ſhould ſurely be no leſs abominable to men. Let us then, by fair experiments, endeavor to demonſtrate the component parts of our ſea waters, in hopes of introducing a rational, inſtead of the prevaling empirical, practice.

§ 52. Sea water, in the natural ſtate, is every where pellucid and colorleſs, as ſpring water. It generally appears in the ſea of a pale, greeniſh hue, beſt known by the name of a ſea green; but, this is onely owing to the colors reflected from the bottom; as thoſe of red, as well as black, that give denominations to certain ſeas, are derived from the ſame cauſe.

§ 53. We commonly attribute a peculiar ſmell, as well as color to the ſea water. But, we miſtake alike in both: For, ſea water has no ſenſible ſmell. Its ſhores and products indeed have a particular ſmell, of which however the water, in the natural ſtate, does not partake.

§ 54. All juſtly agree in its ſalt taſte; but, to this ſenſe, that of bitterneſs ſhould be added in the eſtimate, as both are inſeparable from ſea water.

§ 55. Though from the never ceaſing flux and reflux of the ſea, its waters ſhould ſeem to be pretty equally mixed, and therefore, nearly alike impregnated with ſalt and other matters; yet, we find it differ in

in various parts, as much as any ſalt ſprings can be ſuppoſed. The nearer the equator, the ſtronger is the ſea found charged with ſalt; and the further from it, or the nearer the poles, the weaker is it always impregnated. And that, for theſe obvious reaſons; 1. the waters are hotter under the equator, than at or nearer the poles. Hot water can diſſolve more ſalt, than cold; and, in proportion to its heat, evaporates, more than the cold can; whence, the impregnation muſt be ſtronger. 2. There are fewer rivers to dilute the ſalt water about the equator univerſally, as well as leſs rains, than at the poles; whence, the impregnation muſt here be weaker, or more dilute.

§ 56. Hence, the ſtrength of the impregnation varies from about a ſixth or ſeventh part ſalt in the ſea water about the equator to about a thirtieth, as it is found in ſome parts of the Baltic, particularly near Carlſcroon in Sweden [a].

§ 57. In like manner, it varies upon our coaſts, as we examine it near to, or remote from, the mouths of our rivers, that muſt dilute it in proportion to the quantity of freſh water, they diſcharge into it. The different tides, whether ſprings or neaps, alſo make a ſenſible difference in the ſtrength of the impregnations of thoſe of our ſeas, that waſh our ſhores in general. The higher the tides, the farther from rivers, and the drier the weather, the more ſalt are our ſeas, on all ſides, always found; for reaſons too obvious to require further illuſtration.

§ 58. In order to obtain a more juſt and rational idea of the properties of ſea water, by comparing it with an arteficial ſolution of pure ſalt in Thames water, of equal ſtrength, I made the following experiments;

§ 59. The difference in the ſtrength of the impregnation of one ſalt water and another is demonſtrated by the hydrometer, as well as the common balance; though the proportions or kinds of the ſolid matter diſſolved, may not thus be aſcertained.

[a] WALLERIUS, before cited.

§ 60.

§ 60. 1. In order to take a view of the different impregnations by the balance, I took a phial, ſuch as I uſed in former experiments, weighing with its ſtopple, ounces 2. 4. 0. 14 grains, troy weight.

§ 61. 2. This phial filled with deſtilled water, of fivety five degrees by the Thermometer, weighed — oz. 4. 6. 0. 12

Of this then it contained in weight — 2. 1. 2. 17

In meaſure nearly — 2. 4. 0. 0

§ 62. 3. This phial thus filled with Thames water, of the ſame temperature, weighed ſomewhat leſs than — 4. 6. 0. 12½

§ 63. 4. This phial thus filled with water from the German ſea, off Tinemouth, weighed — 4. 6. 2. 0½

§ 64. 5. This phial thus filled with water from the German ſea, off Harwich, weighed — 4. 6. 2. 2

§ 65. 6. This phial filled with water from the ſea water baths at Harwich, in like manner, weighed — 4. 6. 2. 1

§ 66. 7. This phial thus filled with the weaker Northwich brine, weighed — 5. 1. 2. 6

§ 67. 8. With the ſtronger brine from the ſame ſprings, it weighed — 5. 2. 0. 3½

§ 68. 9. The ſame phial thus filled with ſtrong Droitwitch brine, weighed — 5. 1. 2. 14

§ 69. 10. The ſame phial filled with bittern from the ſaltworks at Maningtree, where Lancaſhire rock-ſalt and ſea-water are uſed, weighed — 5. 2. 1. 7

§ 70. Hence, we may learn the ſeveral relative, not the ſpecific, impregnations of theſe waters. This I took an other method to inveſtigate.

§ 71.

§ 71. I evaporated the phial full of each of theſe liquors, in a ſhallow flint-ware cup, labelled and weighed, to a dryneſs, and having thus determined the fixed ſolid contents, I expoſed them twelve hours to the ſame air, and found the following effects;

a. The cup, in which the phial full of Tinemouth ſea water was evaporated, increaſed in weight immediately after evaporation ——	dr.	0.	2. 0
After being expoſed to the air	—	0.	0. 9
b. The cup, in which Harwich ſea water was evaporated, in like quantity, after evaporation increaſed	—	0.	2. 4
After being expoſed to the air —	—	0.	0. 8
c. The cup, in which Thames water, charged with ſalt in the ſame proportion, was evaporated, in like quantity, after evaporation increaſed	—	0.	2. 3
After being expoſed to the air	—	0.	0. 7½
d. The cup, in which the phial full of Northwitch ſtrong brine was evaporated, in like manner, increaſed —— ——	—	6.	0. 3
After ſtanding the ſame time in open air —— ——	—	0.	0. 12½
e. The cup, in which the ſame quantity of Droitwich brine was evaporated, after evaporation increaſed in weight ——	—	5.	2. 4
After expoſing the ſame time and place to the open air ——	—	0.	0. 5

§ 72. Theſe give the ſpecific fixed contents of each water, and intimate in what proportion each contains the ſalt ley or bittern: For, thoſe that increaſed moſt in lying open to the ſame air for the ſame ſpace of time, contain moſt of that ſubſtance, which is the moſt apt to abſorb the humidity of the atmoſphere and to deliqueſce.

§ 73.

§ 73. There is alſo ſomething obſervable in the manner of each ſucceding in the operation. The weakeſt impregnations, though they contained moſt water, as they did leſt ſalt, were eaſieſt and ſooneſt evaporated; and on the contrary the ſtrongeſt impregnations, though they contained leſt humidity, as they did moſt ſalt, required more time and fire to complete the evaporation; partly from the ſtronger attraction betwixt the ſalt and the water, and partly from a ſaline pellicle, which ſoon covered over the ſurface of the ſtronger impregnations and obſtructed the exhalation.

§ 74. Moreover, though theſe ſeveral ſaline impregnations ſeemed nearly equally colorleſs and bright, they gave ſalts of different degrees of purity and whiteneſs. The ſolution of pure table ſalt in Thames water, when evaporated, left a reſiduum, which was ill colored, comparatively ſpeaking, brown; the reſiduum of Tinemouth ſea water was ſome degrees brighter; that of Harwich ſea water, brighter ſtill than that of Tinemouth; that of Northwich by far more white and bright than any of theſe; this was ſtill outdone in brightneſs and beauty by that of Droitwich; and both, as they criſtalliſed in evaporation were apt to puſh their ſalts over the ſides and verge of the cup. The bittern, though rejected, as I hear, at Maningtree, ſtill contained much ſalt, which might be extracted from it, to advantage.

§ 75. The difference in color ariſes partly from the different portions of the oily matter, earth, and bittern, which each contains. The laſt may be judged by the increaſe of each reſiduum upon expoſure to the open air. The ſecond is ſhewn by the following experiments; I took five coffins of filtrating paper numbered 1, 2, 3, 4, 5. weighed each and noted it exactly. Then, ſet it in a glaſs funnel. And having heated ſome pure deſtilled water, I poured enough upon each reſiduum in its proper cup to diſſolve, what was ſoluble, poured it into its proper coffin, and funnel; and when it paſſed through,

through, added as much more water as washed away all the salt, as appeared by its running through quite insipid. Then having exactly, equally, carefully dried the several coffins together, I weighed them again and found each of them increased and charged as follows;

N°. 1. § 71. a. The coffin, through which the solution of the residuum of Tinemouth sea water was filtrated, weighed before filtration	grains	31½
After filtration, washing and drying, weighed	—	32½
Increase, by a brown earth left behind,		1
N°. 2. b. That of Harwich sea water before filtration weighed	—	29½
After	—	30½
Increase, by a paler earth		1
N°. 3. c. That of Thames water and salt, before	—	32½
The same after	—	34
Increase, by a pale, brown or yellowish earth	—	1½
N°. 4. d. That of Northwich strong brine, before	—	27½
The same after	—	32½
Increase by a pale brown earth		5
N°. 5. e. That of Droitwich, before	—	32½
The same after	—	36
Increase, by a very pale or whitish earth	—	3½

§ 76. These experiments give us a notion of the composition of each water, as to the proportion of earth, which separates from it in evaporation. They that suffers the most and longest heat must always yield most of this earth; because the salt in such cases suffer some decomposition, besides what the waters may hold naturally redundant. Hence, the strongest im-

impregnation, for the moſt part, ſhews leſt earth. This is known to the ſalt workers at Northwitch, Nantwich, Droitwich and elſewhere. The oily matter, the firſt in § 75. appears partly in the color of the ſalt, partly from that of the bittern, when the ſalt is cryſtaliſed. Its coloring alcohol, and being deſtroyed by fire, proves its oily nature in theſe as in the reſidua of ſweet waters.

§ 77. The ſeveral ſea waters and Thames water equally charged with ſalt, proved by the hydrometer or balance, each give appearances ſo ſimilar, 1. in ſtriking a pale or ſea green with ſirup of violets; 2. in ſuffering a white precipitation with alcaline ley; 3. in precipitating the metallic ſolutions of lead in deſtilled vinegar, and of ſilver and quickſilver in the acid of niter, that, they are hardly, if at all, to be diſtinguiſhed the one from the other in producing theſe effects.

§ 78. By the preceding experiments and obſervations it appears, that ſea water differs accidentally, not eſſentially, from the waters of our mediterranean ſalt ſprings; each, when in their kind pure, affording the ſame ſolid or fixed contents, an earth, a muriatic ſalt, a ſalt ley, which gives a bitter purging ſalt, with a ſmall portion of the oily matter common to all waters; all bearing different proportions to the common water; but, no ſulphur nor bitumen; no nitre; none unctuous ſubſtance. Conſequently their mechanical, as well as phyſical and medical uſes, muſt correſpond.

§ 79. Let us view each ingredient apart, and then judge of the compoſition.

§ 80. 1. The earth, or as it is called, the ſand or ſcum of the brine-pits, and that of the ſea are alike calcarious. Being waſhed in deſtilled water and dried, each alike, 1. are ſoft and inſipid; 2. cauſe an ebullition with, and moſtly diſſolve in, all mineral acids, blunting their acidity; 3. being calcined, firſt give a little inconſiderable fume, like any oily earth, and then are converted to lime; as appears by its acquiring an acrid taſte, diſſolving partly in water and giving it all the qualities of water, in which the ſame portion of any common lime is infuſed.

§ 81.

§ 81. 2. The ſalt obtained from each water, when alike perfectly purified from earth, as well as from ley, exactly correſpond in all reſpects, in properties, qualities, uſes and effects; as for example;

a. The cryſtals, whoſe forms have before been given[a], ſtand equally well in the ſame air. Each alike abſorbs ſome humidity in wet weather.

b. Both are alike ſoluble in the ſame proportion of water, as before ſet forth[b].

c. Fuſe alike readily, and being cooled after fuſing, are alike apt to attract the humidity of the air, and run; and the more, the longer they are continued in the fuſing heat.

d. They alike loſe a part of their ſpecific acid in this operation, which is the cauſe of this deliqueſcency.

e. Thrown upon an ignited iron or tile, each crackles, burſts in ſunder, and falls into a ſeeming powder; which viewed in a microſcope exhibits moſtly cubical figures.

f. Projected upon expiring coals, they alike burſt with a crackling exploſion; blow up the fire and reanimate it, as if by ſo many little bellows, and give a pale blue flame.

g. In this, they are both alike volatiliſed: For, any metallic plate held over the thus decrepitating ſalts, are alike covered with a white ſaline powder; which from its giving ſome degree of whiteneſs to copper, is looked upon to bear ſome affinity to arſenic; or to the mercurial principle.

h. With the nitrous acid, in the ſame proportion, mixed and deſtilled, each gives the like quantity of the acid of ſalt, compounded with that of nitre, and thereby conſtituting an aqua regia. And,

i. The reſiduum of each proceſs, by ſolution and evaporation, gives alike cryſtals of quadrangular nitre.

k. With any of the bolar earths, the ſalt of the brine pits and that of the ſea water give alike, by deſtillation in a ſtrong fire, ſubtil white fumes, which

[a] General IDEA of Salts, § 77, &c. [b] Part I. § 118, 119, 121.

dif-

difficultly condenſe into the ſpecific acid of ſalt, of a pale greeniſh yellow color.

l. With the heavy vitriolic acid, an ebullition and efferveſcence, with ſubtil, penetrating and almoſt incoercible white fumes ariſe alike from the ſalt of each water; theſe being condenſed afford an acid like the preceding, fuming upon being opened. The reſiduum of each affording an arteficial vitriolate ſalt, bearing the name of its inventer, Glauber.

m. Neither of theſe acids affect gold; which they muſt have done had the ſalt contained any nitre. But, they alike precipitate ſolutions of quickſilver, ſilver and lead, rendering each ſemivolatile; giving with the firſt, that volatile, though moſt ponderous, metallic fluid, quickſilver; by ſublimation, the corroſive ſublimate of mercury; a ponderous, ſolid, cryſtalline body, in which its fluidity is loſſed, as well as its volatility reſtrained; and rendering the fixed, ſolid metals near equally volatile and ſubtil with mercury.

n. In like manner, the concentrated acid of either, propelled by fire, meeting with mercury, regulus of antimony, or tin, in convenient veſſels, and in a ſtate of diviſion, they ſeverally attract each other and form different ſemivolatile or volatile concretes or liquors; as for example, with quickſilver, corroſive ſublimate; with regulus of antimony; the ice-like ſubſtance, called butter of antimony, and with tin, that ſubtil, volatile liquor, which flies off in a thick white fume upon being expoſed to the air. Which properties are peculiar to the acid of ſalt; and therefore, it is judged of all others to contain moſt of the mercurial principle; whence, its greateſt affinity or attraction with the moſt mercurial metals and metallics is preſumed to ariſe.

o. The acids of theſe ſalts have a like ſingular effect upon volatile alcalies: Though this ſalt and the acid before union were each volatile; they mix with a ſtrong ebullition, without any ſenſible loſs, and being ſaturated, give a ſemivolatile concrete, ſalt ammoniac.

p. In

p. In like manner, the acid of each ſalt mixes and unites with a fixed alcali, and then gives a ſalt correſponding in appearances, properties and effects with ſea ſalt: Which demonſtrates theſe acids to be alike the pure acid of muriatic ſalt, and this acid and a fixed alcali, the conſtituent parts of ſea ſalt; of which, this may be conſidered, as the regeneration.

§ 82. Here, it may not be improper to obſerve, that a fixed alcali may be uſed as a kind of a teſt of ſalt: An alcaline ley dropped into any ſolution of ſalt, the acid quits its mineral to take to itſelf a vegetable baſe: Hence, a precipitation of the original baſis of the ſea ſalt enſues. But, the more terrene matter adheres to the ſalt, or the more apt it is to run in the air; the greater the quantity of the precipitate; conſequently, the ſalt, which yields the leſt precipitate is the pureſt. The ſalts in queſtion, when equally pure, give a like proportion of this precipitate. The liquor, from which this is ſeparated gives a regenerated ſalt; that is, a muriatic ſalt, with a vegetable, inſtead of a mineral, alcaline baſe.

§ 83. Theſe experiments ſerve at once to ſhew the general characteriſtics of ſalt, and to ſhew the analogy between that obtained from our mediteranean ſalt ſprings and that from the waters of our ſeas. e, f, g, h, i, k, l, m, n, o, p, ſhew both our ſea and ſalt ſpring waters void of nitre [a].

§ 84. 3. The ley of ſea water or bittern agrees in all reſpects with that of our brine pits; except in being in greater proportion in a given quantity, and ſomewhat higher colored in that, than in this; from its containing more of the oily matter, as well as ſome of the bitter, priſmatic ſalt; both ariſing from a greater and longer expoſure to the open air. Some of our ſprings yield little or no bittern, as thoſe of Droitwich. And upon the whole, I can perceive no difference between this calcarious ſalt or this ley, and that, which reſults from the waſhing and eva-

[a] From § 32. to § 45.

porating the reſidium after evaporation of the river and ſeveral pump waters of London [a].

§ 85. The gentlemen, who talk of bitumen, nitre and unctuoſity in ſea water, muſt not ſurely mean the ocean in general. That ſome particular ſeas and ſalt lakes contain bitumen, is very well known; but, that this does not extend to the ſeas in general, or to theſe however, that environ us, is evident to demonſtration. But, there is no more evidence of theſe waters containing nitre, either ancient or modern; or any kind of unctuous matter, than there is of thoſe being found in common ſalt or ſimple ſprings, rivers or lakes.

§ 86. The efficacy of ſalt water in general is to be aſcertained from the nature of its compoſition, which is to be judged from the quality and proportion of the ingredients, with which it is impregnated. Here, I ſhall confine my views ſolely to the purely ſalt waters of our ſprings or ſeas; leaving ſuch as are complicated with any metallic or truly bituminous matter to be conſidered under other heads.

§ 87. The ley has not yet obtained as much as it deſerves in rational practice. The learned and ingenious POTT, who chooſes to call it by a whimſical unmeaning name, that of fixed ſalt ammoniac; ſays, it is ſeptic and diuretic; and, being mitigated by the mixture of the juice of nightſhade, is uſeful in tetters and in ganglions. He recommends, to our further examination, an aſſertion of Solingen; that this ſalt extracts matter from the head, without opening the ſkin, by the bare application onely. See this great man's Diſſert. de Sale communi.

§ 88. However ſome gentlemen may of late have plumed themſelves upon introducing a more frequent uſe of ſea water, I might have ſayed, bringing it into faſhion; it is moſt certain, they have ſtarted nothing new upon this ſubject; and have at beſt onely revived

[a] See Part I. § 283. 3. § 308. 3. § 320. 3. § 350. 3. § 37. 3. § 359. 360. 361. 364. 366. 367. 368.

an

an empyrical uſe of theſe waters, more irrational, and in all reſpects, inferior to that of the moſt inconſiderable among the antients, who at all glanced at the matter.

§ 89. Nothing leſs than a thorough ignorance of the materia medica, or of the nature of medicines, a total unacquaintance with the variety of changes, which ſimples, by bare mixture, may work upon one another, can prompt men to run into the endleſs, not to ſay incongruous, compounds to be ſeen in the practice of ſome, dignified with the venerable titule of phyſician. Bad marks-men think themſelves ſureſt in their aim, when they load their piece with a number of ſlugs; they then preſume, it is hard, if ſome or other of them do not hit the mark, though they ſhoot ever ſo much at random. But, the true marks-man, when he knows his powder and his barrel, and rightly judges the diſtance, is always moſt ſure of hitting his mark, when he charges judiciouſly with one bullet onely.

§ 90. There is a moſt ſhameful and abominable practice run into by many phyſical writers, which can not be ſufficiently expoſed, to be, as ſoon as it ſhould be, exploded. This is generally the error of a man prompted by enthuſiaſm, or ſome weaker, if not a worſe, motive, to ſit down to write upon ſome particular ſimple. Few can well admit of a volume. It is thought below the dignity of a phyſician, and ſeldom found to anſwer his purpoſe, to write leſs than a volume. A volume then muſt be written; let the materials be found where they may. Few books, that have not ſuffered ſome accidental injury, want a titule page. Yea, in ſome there is a running titule to every page. Yet, upon peruſing the text, good heavens! how few are there, that bear any relation to the titule they bear! — It would be foregne to the intention of this eſſay, if not a taſk equal to the cleanſing the augean ſtable, to enter into a general criticiſm upon ſuch nameleſs authors. I ſhall therefore onely curſorily

glance at one, ſomewhat relative to this ſubject, whoſe front titule ſtands, DE TABE GLANDULARI, SIVE DE USU AQUAE MARINAE IN MORBIS GLANDULARUM DISSERTATIO. Auctore RICARDO RUSSELL, M. D. and the running titule over every following page, is DE USU AQUÆ MARINÆ [a].

§ 91. The great SWIFT, that ſevere ſcourge of the vices and follies of his time, upon being abruptly accoſted by a petulant, aſſuming brother of the robe, with ſome coarſe compliments upon his writings, replied, "I ſee, Sir, you have read but the "worſt part of my works."—A juſt rebuke for his not ſhewing ſome edification by his reading. I fear I ſhall have the ſame mortification with the unbred country parſon, if Doctor RUSSEL ſhould by any accident hear, that I confeſs, I looked into his book, and there read but little more than the Recipes, that embeliſh almoſt every page. Theſe alone were enough to give me an idea of the practical part of this learned and elaborate diſſertation: For, I ſoon found, that among the number of curious hiſtories, curiouſly related, there is hardly one, in which Sea water was fairly relied on, or can be ſayed to have acted any conſiderable part in, much leſs to have wrought, the cure.

§ 92. The firſt preſcription, that attracted mine eye, was that, in which vitriolate tartar and ſalt of tartar are mixed; a curious attempt to non-neutrate neuter ſalts; the happy invention of which, will not, I dare ſay, be diſputed with the Doctor, by any of his fraternity.

§ 93. The ſecond is a moſt judicious compoſition of pills, with Wood-lice, Venice Soap, Gum ammoniac, &c. and a wine medicated with ſalt of wormwood, ſuggar and oil of nutmeg; which, with pro-

[a] This tract has been publiſhed in Engliſh, under the titule of, A DISSERTATION concerning the uſe of SEA WATER in DISEASES of the GLANDS, &c. By Richard Ruſſell, M. D. and F. R. S. but, which is the original, or whether or no both were publiſhed by one and the ſame man, I can not take upon me to aſcertain.

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per cordials, cured a woman of an inveterate dropſy, making her void ſixteen ſtones, as large as the marbles, that boys play withall. But, I have not found, that any ſea water was taken or preſcribed. How much this may be to the purpoſe, let the author and his friends determine.

§ 94. After this, I find thirty nine hiſtories of particular diſeaſes, which, I take it for granted, are introduced, as proofs of the ſanative virtues of ſea water. How they may affect others, I know not; but, to me, they are no more proofs of the efficacy of ſalt water, than they are of that of any of the ſimples in the great variety of ſhop compoſitions preſcribed, to the taking of which, the drinking of ſalt water was often forced to give place.

§ 95. I would not be thought to reflect upon this very eminent phyſician's practice. The ſpecimens of it, here given, would certainly merit ſome attention, had they been ſet forth in any practical diſſertation, without aſcribing the cures to any one of the ſimples, but to the whole compoſition exhibited: For, if it be not impoſſible to aſcertain the prevaling remedy, in the variety of compoſitions given, in the generality of the caſes recited; it is at leſt certain, that no man can with appearance of propriety, attribute the cures here performed more to the ſea water, than to any of the other drugs. Yea, there is juſt reaſon to apprehend, that the courſe preſcribed in moſt, if not all theſe caſes, might have been performed in any clear air, with the other medicines, putting ſea water quite out of the queſtion.

§ 96. To give a clearer notion of this matter, let us look over the Doctor's materia medica, and we ſhall find, that he has varied little or nothing from the ordinary courſe of practice; except in interpoſing now and then a draught of ſalt water; on the nitrous, bituminous and unctuous qualities of which, he ſeems to lay no ſmall ſtreſs in his preface. We find then, the Doctor never truſted to his favourite ſalt water a-

lone in any caſe; but, gave all the ſweetening, reſolvent, deobſtruent and aperient medicines of the ſhops: Theſe were Æthiops mineral, Sulphur and its precipitate, Nitre, ſalt of tartar and other alcalies; Tincture of ſalt of tartar and other ſolid ſoaps; Millepedes or Woodlice, Whitlow graſs, Camphor, abſorbent earths of all kinds, as crabs eyes, crabs claws, ſponge, cuttle fiſh bone calcined into a ſort of lime, corral, and other like animal productions of the ſea, and common ſea wreck burned, the kelp of the ſoap-boilers and glaſs makers, conſiſting of an alcaline ſalt, ſea ſalt and an abſorbent, vitrifiable earth, with much inherent phlogiſton; a moſt noble medicine, which lyes concealed in the Doctor's preſcriptions, under the titule of Æthiops vegetabilis, inſtead of the plane name of ſoda or kelp; likewiſe Glauber's Salt, Senna, Rubarb, Ipecacuanha, the moſt powerful preparations of mercury, ſuch as Calomel and Turpeth mineral, in large doſes; Antimony, Lime water; Balſam of Cupivi; Sperma ceti; Vipers; gum Guajacum; compound powder of Arum root; volatile ſalt of Hart's-horn; ſpirit of ſcurvy-graſs; Tincture of Antimony; Polychreſt balſam; and for topical applications, the mucilaginous juice of the ſea weed, or the entire plant; alcaline leys with ſea water; Tutty or Calamy, &c. &c. &c. With an ointment, which might have been more powerful, as it is well known in practice, had it not been ſpoiled in the making. The compoſition is elder bark, half a handful, elicampane root in powder, two drachms, ſheep ſuet and tar, of each ſix ounces, boiled together, till the elder bark becomes criſp; at which time, the tar is ſpoiled of its moſt excellent virtues, by the loſs of its eſſential oil; whereas the Doctor might have had a better medicine, by onely mixing the tar by melting with ointment of elder, or even with ſuet or plane butter.

§ 97. Now, is there any phyſician, that looks over this long catalogue of the moſt powerful medicines, moſt of them authoriſed by antient and modern

dern practice, that, when with theſe furniſhed, could think himſelf at a loſs for remedies in any chronic caſe; though he were never able to get a ſingle drop of ſea water for his patients? — Or, can diſorders, in which theſe were freely given, be ſayed to have been cured by ſea water alone? — Is this the method of ſhewing the genuine virtues of any medicine? — Sure, no man in his ſenſes can inſiſt upon it! — I do not call the judgement or veracity of this eminent practicioner in queſtion: I believe every hiſtory, he relates. I onely think, that like moſt of the phyſicians of water drinking places, he has miſtaken the titule of his book in the firſt place; and, in the next, that he aſcribes cures to the ſea water, when it confeſſedly had the ſmalleſt, if any, ſhare in the effect. Long may Doctor RUSSEL live to comfort and relieve the diſtreſſes of human nature, at Brighthelmſtone, or wherever elſe he liſts! but, if he means to inſtruct us in following his ſalutiferous ſteps; let him fairly point out the way. At leſt, let him not ſend us to ſea, unneceſſarily, and leave us there, in an open barque, and without a pilot.

§ 98. I wiſh with all mine heart, that a trite proverb had leſs truth, than we find in it; What is every body's buſineſs is no bodies buſineſs; that is, no body will be got to ſet about, what every body ought. An adage not unlike this may be made in phyſic; What is good for every diſorder, is good for none; that is, what is, through ignorance or craft, cryed up, as an univerſal medicine, is often found to anſwer few or no good purpoſes in any diſtemper.—In this ſenſe, both will appear equally true to the obſervant. And ſo much am I perſuaded of this truth, that I had rather truſt to any of the abuſed remedies of old women and nurſes, than to the authorities of moſt of the writers upon ſpecific or even upon particular medicines; eſpecially upon mineral waters; for, ſuch, from ſome motive or other, are rarely to be confined within the narrow limits of truth and right reaſon.

§ 99. I would not be here thought to intend to depretiate ſalt or ſea water. There is not a medicine in the materia medica, higher in mine eſteem, nor one, whoſe ſhameful diſuſe or abuſe, I more lament, than ſalt or ſea water. And therefore, it muſt be preſumed, that I wiſh for nothing more, than to ſee this excellent remedy reinſtated; for, ſo I may call its being brought now into practice; ſince, the antients ſeem to have extended the medicinal uſes of it, further than any of our more enlightened moderns can boaſt.

§ 100. If we look into any of the celebrated writers of antiquity upon the materia medica, we ſoon find in what high eſtimation they held ſalt and ſea water. In the number of theſe, DIOSCORIDES juſtly demands the firſt rank. It may not be diſagreeable to thoſe, who have not leiſure or opportunity of looking into the originals, to read the ſentiments of this famed phyſician, and ſome others of the antients, upon ſalt, ſea water and brine, in our native tongue. This will at once vindicate theſe venerable authors from the obloquy, attempted to be thrown upon them by ſome, who would paſs their works upon the world for originals.

§ 101. The antients well knew the choice of ſalt. DIOSCORIDES [a] prefered the pure, pellucid, foſſil ſalt, our ſalt gem, to all other kinds. Of thoſe extracted from ſalt waters, he choſe that, which he found moſt white, ſolid, conſiſtent and uniform. Among theſe, he judged the marſh ſalt, or that made by the evaporation of ſalt or ſea water by the heat of the ſun, the beſt; and among the ſalts of this kind, gives the preference to thoſe, made in Cyprus, Sicily, and Africa. In which judgements, GALEN [b], PLINY [c], and MATHIOLUS [d] join.

§ 102. Theſe moſt reſpectable ſages agree in the medicinal virtues of ſalt, and tell us, that all ſalts of this claſs are of moſt extenſive utility; being aſtrin-

[a] De Mater. Medic. cum Comm. Mathiol. lib. v. c. lxxxv.
[b] De ſimp. med. facult. l. xi. c. de ſale, et l. iv. c. 19.
[c] Natur. Hiſt. l. xxxi. c. 7.
[d] In Dioſcor.

gent,

gent, abſterſive and deterſive, diſcutient, reſolvent, extenuent, and, in ſome meaſure, ſeptic, and preventative of putrefaction; that ſalt is an excellent topical application for the itch; that it reſtrains the growth of fleſhy excreſcencies univerſally, more eſpecially in the eyes; where it is ſayed to conſume that preternatural membranous expanſion, called Pterygion; that it is proper in clyſters; that, mixed with oil and applied by unction, it refreſhes wearied limbs; that it reduces hydropical ſwellings; that applied warm, in nodules or ſacks, it aſſuages pain; that, mixed with oil and vinegar, and rubbed in, till the part ſweats, it corrects itchings and cures tetters, leproſies, and the itch; that, mixed with honey, vinegar and oil, it eaſes the quinzy; and with honey alone, relieves tumors of the tonſils and palate; that it is applied in humid and rebellious ulcers, particularly of the mouth and gums, mixed with barley meal; that it is ſerviceable in the ſtingings of waſps; againſt inſects, that breed in the ſkin; againſt ſcald-heads, warts and tubercles, in the form of an ointment with veal ſuet; that it diſcuſſes boils, in form of a pultis with raiſins, hog's lard or honey; and ſuppurates tumors of the teſticles, with marjoram and yeſt; that it diſperſes livid or black ſpots from ſtrokes on the ſkin, being mixed with honey and applied; that it is applied to ſtrains with meal and honey, pultiſwiſe; and that, mixed with oil and layed on burned or ſcalded parts, it prevents bliſtering; that it is thus applied to the gout in the feet; that with vinegar it eaſes pains of the ears; and with that and hyſop, reſtrains St. Anthony's fire, and other ſpreading ſores; that the poiſons of opium and muſhrooms are corrected by drinking ſalt diſſolved in vinegar; and that it is ſerviceable againſt the bites of ſcorpions, ſerpents, and other venomous and inraged animals, with various other ſimples in various manners applied. Theſe are taken from DIOSCORIDES; to the principal parts of which, the reſt of the antients agree, particularly PLINY, who ſeems but to copy and ſomewhat, but not materially, to enlarge.

§ 103.

§ 103. Theſe ſages juſtly conſidered Ἁλὸς ἄχνη, Haloſachne, or Spuma ſalis; Ἅλμε, Halme, Muria, or brine; Γάρρου, Garron or Garum, Fiſh brine; Ὕδωρ Θαλασσιον, Hudoor thalaſſion, Aqua Marina, or ſea water; Οἶνοι Θαλασσιοι, Oinoi thalaſſioi, or Οἰνογάρου, Oinogaron, Garum vinoſum, Salt wines, made with grapes, or their juice, and ſea water, or brine, and Θαλασσόμελι, a kind of ſalt mead, or a mixture of honey and ſea water boiled, or of honey and ſea, with ſome rain, water, mixed and kept in a pitched veſſel during the dog-days; all in much the ſame light. DIOSCORIDES [a], whom moſt of the ſucceding antients copy, ſays, ſea water is hot and acrid, diſagreeable to the ſtomach and offenſive to the reſt of the inteſtines; yet, carries off pituitous humors. Applied warm, by way of fomentation, it cleanſes and diſcuſſes, is ſerviceable in diſorders of the tendons, and relieves whittle-flaws, before they exulcerate. It is mixed with plaſters, in cataplaſms with barly meal, and with other diſcutient pultiſes. It is drank warm, to diſcharge the inteſtines; hot, to eaſe colic pains or gripes. By waſhing, it corrects erruptions and foulneſſes of the ſkin; ſuch as the itch, tetters and vermin; and is an uſeful fomentation for turgid tumors of the breaſts. It diſperſes black and blew ſpots from ſtrokes, or bruiſes on the ſkin, and is eſteemed proper for the bitings of ſuch venomous animals, as are attended with ſhuddering and chilneſs; eſpecially thoſe of Scorpions, Tarantulas, or other venomous Spiders, and Aſps; theſe are relieved by warm, ſea baths, which are alſo found beneficial in chronic diſtempers of the body and diſorders of the nerves. The ſteam of ſea water relieves dropſies, pains in the head, and deafneſſes. Upon being kept a while, without adding pure water, it becomes more mild. Some boil it, and ſo keep it in that manner. It is given as a purge, either pure, or mixed with wine, or wine and water, or with honey. But, to correct its acrimonious effects, chicken or fiſh broth is given during, or after, the purging. To theſe ſentiments of Dios-

[a] Edit. cum Com. Mathioli, l. v. c. 15.

CORIDES,

CORIDES, the reſt, in a great meaſure, ſubſcribe; particularly, P. ÆGINETA [a].

§ 104. The Father [b] of phyſic judged much alike of ſalt and ſalt waters; but, does not expatiate ſo far on their uſes as his ſucceſſors, and ſeems to confine himſelf chiefly to the external uſe of ſea water, prefering it in warm fomentations and baths. He ſays, that ſea water in this manner applied is ſerviceable in itchings and other ſharp uneaſy vellications of the ſkin. He obſerves, that for ulcers ariſing from burns or ſcalds, excoriations, and the like, it is improper; while it is fit for ſimple ulcers; that it powerfully promotes the cicatriſing of theſe foul ulcers, that are not to be digeſted without ſome degree of vellicaion; ſuch as the ulcers of fiſhermen in particular. He likewiſe recommends the moiſtening the rollers layed on broken limbs under the ſplints, with ſea water. And alſo tells us, that it corrects ſpreading ulcers, as ſalt, brine and nitre do. He remarks, that all theſe ſparingly applied irritate; but are found more effectual, when more freely uſed. And gives warm ſea baths the preference.

§ 105. GALEN [c] agrees in aſcribing warming, drying aſtringent and deterſive qualities to ſalt and ſea water, and recommends the affuſion of it warm upon inciſed gangrened parts. Moſt of the ſucceding chirurgical writers, down to the moſt celebrated among the moderns, have embraced this opinion; but, how little this or any other topical application is to be relied upon in gangrenes, I have already endeavored to explane, in the Theſis [d], which I ſuſtained for the degrees in phyſic at Leyden.

[a] Lib. vii. c. 3. [b] HIPPOCR. de humid. uſu. Sect. vii.

[c] De ſimp. medic. fac. lib. 1. c. 7.

[d] Whoſe titule is, Diſſertatio Medica Inauguralis de GANGRAENA et SPHACELO. Quam, favente ſummo Naturae Parente, ex auctoritate Magnifici Rectoris, nec non Ampliſſimi Senatus Academici conſenſu, et Nobiliſſimae Facultatis Medicae Decreto, pro Gradu Doctoratus, &c. Eruditorum Examini Submittit CAROLUS LUCAS, Britanno-Hibernus, Civis Dublinenſis, Patria, Factione *Harringtoniana*, expulſus, &c. Lugd. Batav. apud G. WISHOFF, 1752.

§ 106.

§ 106. Muria and Garum are to be conſidered as they may be ſimple or compound, new or old. By the firſt ſome underſtand nothing more, than water, ſo charged with ſalt, as to bear up an egg; others, brine or pickle, in which meats of different kinds have been cured. By the ſecond, the brine or picle, in which fiſhes have been cured. Theſe are in general more ſharp, penetrating and reſolvent, than ſimple ſolutions of ſalt; and they are rendered ſtill more ſo by time, in which they undergo ſome degree of putrefaction.

§ 107. Whoever then conſiders the uſes and purpoſes, to which the antients applied ſalt in a dry form, or diluted with water or other fluids, will find, that theſe moderns, who are not very converſant in chemiſtry, have not much ſuperior knowledge of the matter to boaſt of from any of the new diſcoveries in other parts of phyſic; and that ſalt, in different forms, was ſucceſsfully applied in a greater variety of caſes, by the former, than the later.

§ 108. Chemiſtry alone can enlighten the ſubject: This gives us the conſtituent parts of ſalt and of all liquors impregnated with it, and ſhews us the proportions they bear, the one to the other. From theſe alone, the qualities and virtues of the mixed are to be determined; and by theſe, their doſes and manner of operation are to be aſcertained. And hence, a rational, inſtead of an empyrical, practice is to be inſtituted.

§ 109. We find then, that our pure ſalt and ſea-waters contain, 1. the fluid element, ſimple water; 2. A certain portion of two kinds of ſalt; the one reſulting from an union of the ſpecific acid, which, for reaſons before given, is judged to be the univerſal acid ſubtiliſed and altered by the imbition of the mercurial principle; with the native fixed or mineral alcali, conſtituting that ſalt, which is known by the name of the place or matter, whence commonly taken, ſea or muriatic ſalt; or from the uſes, to which it is ordinarily put, common, eſculent or culinary ſalt; the other,

other, from that of the ſame peculiar acid with a calcarious earth, conſtituting the ley or mother of ſalt, or bittern; which, upon imbibing from the air, ſome of the univerſal acid in the place of its own; gives that neuter, bitter, purging ſalt, called from the ſpring, in which ſuch a ſalt was firſt diſcovered with us, Epſom ſalt; 3. an abſorbent, calcarious earth, which ſeparates in the evaporation: For, let this be quickly or ſlowly performed, ſome decompoſition muſt enſue; ſome of the acid muſt be deſtroyed, ſome fly off, as appears in deſtilling ſea water; whence, ſo much of the terrene parts, as have loſſed their ſolvent, ſeparate and ſubſide or riſe in a pellicle or ſcum upon the evaporating water; 4. an oily ſubſtance, from which no water is free, and that in a proportion not eaſily aſcertained, from the difficulty of ſeparating it from the bittern; but probably, not much greater, than it is found in lake, river, and even pump waters; ſo that neither the quantity or quality of this oily matter can, in mine apprehenſion, intitule the ſalt or ſea waters to the appellation of unctuous or bituminous, more than the bitter, purging ſalt denominates them nitrous, as they are generally deemed.

§ 110. From this compoſition, it is eaſy to conceive what kind of medicine is to be obtained from Salt or Sea water, by conſidering firſt the nature of each ingredient reſpectively, and then, the reſult of their combination. The virtues of ſimple water have been already explaned[a]: The conſtituent parts of ſalt and its ley or bittern, with the oily matter inherent to the later, have alſo been demonſtrated; from the union and proportion of theſe, the virtues and uſes of the compoſition, called Salt or Sea water, is to be judged. The earth is to be conſidered as a part of the compoſition, which does not ſeparate from the water, in the natural ſtate, nor probably in the animal oeconomy; but, is to be reck-

[a] Part I. § 371, and following.

oned

oned with the bittern; for, before the change, it is moſt likely, it acts the part of an abſorbent earth diſſolved in the muriatic acid; and therefore, correſponds in qualities with the bittern.

§ 111. In the general idea of ſalts prefixed to this eſſay, as well as in the preceding part of this head, the relation, the acid of ſalt bears to a great variety of bodies, has been explaned. Here, we are chiefly to conſider its medicinal virtues.

§ 112. The acid, like the reſt of the mineral claſs, is found upon mixture to coagulate the mucilaginous juices of animals, ſuch as the glare of eggs, the cryſtalline and vitreous humors of the eyes, as alſo milk, blood, &c. Glauber recommends it, inſtead of rennet, for the making cheeſe. From theſe properties, ſome are apt to conclude, that, as it produces this effect, when in large quantities mixed with theſe juices extravaſated; ſo it muſt work ſimilar effects when internally taken. But, this judgment will appear but premature to thoſe, who conceive the difference between adding this in large quantities to theſe juices, when extravaſated and ſtagnant, and introducing it gradually, diluted, perhaps altered by the digeſtive and ſecretory organs, into veſſels, which are compoſed of ſenſible and irritable fibres, capable of moving and forcibly breaking and mixing their contents, proportionably to the ſenſe impreſſed upon them by the contained fluids.

§ 113. We find then, that this acid corrugates the fibres of an animal body, as well as thickens the lymphatic and mucous juices, when the body is lifeleſs. But, it muſt ſtimulate the ſenſitive fibre, which will therefore, by a certain mechanic impulſe implanted in nature, exert it ſelf to ſhake off the irritating body. In this conflict, the juices muſt be propelled through their canals; that is, the circulation, and conſequently the comminution, with a due ſecretion and excretion, of the juices muſt be brought about. Hence, we find the acid of ſalt moſt powerfully prevent

vent the putrefaction of vegetable, as well as animal bodies; in which it corrugates or contracts and hardens the fibres. And thus, fermented ſpirits charged with this acid will keep all parts of animals for ages, free from corruption; and water thus charged will keep theſe or vegetables ſound for a great length of time.

§ 114. Hence, the great efficacy of this acid in all putrid and putreſcent diſpoſitions of the humors, in the firſt or ſecond paſſages, moſt evidently appears. Its effects on the delicate fibrillae of the inward coat of the ſtomach is ſoon ſenſibly perceived, by exciting a ſenſe of hunger; whence, it becomes a moſt excellent remedy for ſuch lax, foul, phlegmatic ſtomachs, as neither crave, nor rightly digeſt the neceſſary aliments.

§ 115. But, the efficacy of this moſt ſubtil, penetrating acid is not confined to the ſtomach and inteſtines; where, while it reſiſts putrefaction and deſtroys worms, it ſtimulates their nervous coats, and freeing them from ſluggiſh inaction, excites them to exert their functions, to ſecrete and excrete their contents; no; it is extended to the moſt remote receſſes of the human frame. In perſons having ulcers, or even fontanels or iſſues in any of the extremities, if ſome doſes of the acid of ſalt be given, a pricking, ſharp pain is frequently felt in the affected part. It likewiſe manifeſts itſelf by irritating the lungs, eſpecially if they be tender, ſo as to excite frequent coughing. Whence, it is to be cautiouſly, if ever, given to perſons ſubject to pulmonic complaints of the inflammatory kind; while it may be found very ſerviceable in ſome kinds of cold, humid, ſluggiſh aſthmas.

§ 116. The power of this acid is likewiſe extended in an eſpecial manner to the urinary ducts: For, nothing is known more effectual in promoting theſe diſcharges, and in relieving ſuch ſtranguaries, as often attend the extremes of life, youth and old age, from a relaxation of the coats of the bladder about its neck. This acid, by gently ſtimulating, braces up or conſtringes

ſtringes the fibres, and prompts them thus to exert themſelves and propel or diſcharge their contents.

§ 117. Some of the antient chemiſts, not without reaſon, greatly recommend this acid mixed with various vegetable oils, as the moſt powerful embrocation for reſolving calloſities, and rigid contractions of the joints; for nodes and ſcirrhous tumors in general; for palſies and atrophies, or waſting or pining of particular limbs, and for the gout.

§ 118. For theſe purpoſes, it may be beſt uſed with rectified ſpirit of wine, with which it mixes better than with any oily or unctuous body; though this does not ſo intimately, as the acids of vitriol and nitre, unite with ſpirit of wine: for, theſe do not part in deſtillation, but more intimately and inſeparably blend, become dulcified, as it is called, that is, abate of their acidity, and render the ſpirit highly aromatic, ſubtil and volatile. Whereas this, raiſes the odor a little, without abating ſo much of its own acidity, or increaſing the volatility of the ſpirit, from which it parts, remaning laſt, in deſtillation. Some judge, that long digeſtion and frequent cohobation bring about a perfect dulcification and intimate union of theſe, if both be perfectly dephlegmated. However that may be, one part of the concentrated, fuming acid of ſalt mixed and digeſted with three or four parts of pure alcohol, gives a moſt convenient and uſeful form of mitigating this acid, and of applying it, whether internally or externally: For which purpoſe, it is to be wiſhed, it were better known in practice.

§ 119. In whatever form, we find this acid in nature, which is never by itſelf, but always combined with ſome terrene baſe, that moſt powerfully attracts it; ſuch as a ſubtil calcarious earth, or the mineral alcali, with which it is to be found joined in various parts of the earth, in moſt ſprings and other waters, whether ſalt or freſh, particularly in the ſea, as well as in ſome vegetables and in the juices of moſt animals; it always retains its own nature and qualities,

ſuch

ſuch as the antients before recited, and others, by experience found them. Connected to a volatile alcaline baſe, with which it forms ſalt ammoniac, as well as charged with a fixed mineral or vegetable alcali, it preſerves bodies from putrefaction; if there be not too much moiſture; in which caſe, it will in time putrefy; With theſe, it is a very powerful reſolvent, diſcutient, detergent, abſtergent, aperient, diuretic, and deobſtruent. In theſe later qualities, that charged with calcarious or abſorbent earths, the ley of ſalt, or bittern, fully correſponds. And by reſolving viſcidities of the juices, and ſtimulating clogged, ſluggiſh fibres to due ſenſibility and a proper exertion of their functions, a great variety of obſtructions and tumors of the indolent kind and in the glandular ſiſtem eſpecially are moſt effectually and happily relieved by this muriatic and this calcarious ſalt. Its efficacy in which, preferable to all other ſalts or other known medicines, I can attribute to none other cauſe than that, that produces ſo powerful an attraction between the acid of this ſalt and quickſilver, antimony, tin, lead and ſilver and gold; which I take to be owing to affinity; theſe metallics and metals, as well as this ſalt, being ſtrongly endued with the third earth of BECHER, the mercurial principle, as before obſerved. [a] To this, the efficacy of quickſilver, in which this principle abounds, more than in any other ſubſtance known, may be aſcribed. It is none objection to this notion, that quickſilver is found injurious, where ſalt proves effectual; particularly in ſome glandular obſtructions and tumors. That may be owing to the ponderous metallic earth, with which this principle is joined in the quickſilver, and which can not be ſeparated from it or act apart, with the ſubtility of a principle, in the oeconomy.

§ 120. Salt is juſtly deemed a drier, as may appear

[a] See Idea of Salts § 13. 3. § 55. P. II. § 81. n.

by the experience of the antients, and the manner of accounting for its operation; which is thickening certain juices, while, by vellicating the nervous, the irritable, fibres, it cauſes ſuch an exertion of the ſolids in general, as to propel and diſcharge aqueous humidity by the cutaneous pores and urinary ducts. Hence, it muſt alſo heat, in ſome degree. All which experience confirms.

§ 121. From theſe conſiderations, ſome uſeful cautions in practice, as well as in the common oeconomy of life, are naturally ſuggeſted. Salt is uſed with propriety in our food and ſauces, to which it gives a grateful reliſh; while it promotes the digeſtions, ſecretions and excretions. We have alſo pointed out its general uſes in medicine. But, from the qualities laſt explaned, it appears, to what habits of body it muſt be ſuitable, and to whom it muſt prove injurious. In all arid, hot and bilious temperaments, where the tongue is dry and clammy, with a ſaltiſh or bitter taſte, a ſharpneſs and heat of urine, with a conſtant deſire to void it; with ſharp, tickling rheums about the cheſt or throat, attended with frequent coughings; eſpecially with ulcerations of theſe parts; where the ſkin feels dry and criſp, without any perceptible moiſture, and where there is a general coſtipation of the lower bowels; in other words, a preternatural tenſion and criſpature of the fibres; in all ſuch caſes, ſalt in every ſhape and quantity muſt prove more or leſs offenſive.

§ 122. Therefore, ſalutary effects are to be expected from it onely in the oppoſite temperaments, the phlegmatic, cold conſtitutions; where the ſolids are overloaded with humidity, and thence become cold, inert, and ſluggiſh; in other words, where a preternatural relaxation of the fibres prevales; In theſe, and conſequent caſes, ſalt in every ſhape muſt be as beneficial, as neceſſary, as it muſt, in the preceding, be noxious or injurious. This is alſo confirmed by daily experience and obſervation.

§ 123. However, it may be taken to exceſs, in almoſt

almoſt any caſe, and produce deſtructive effects. Of which, a remarkable inſtance is given by our royal ſociety, [a] of a girl at Leyden; who from taking as great a liking to ſalt, from about the age of ſix, as other children commonly have to ſugar; when ever ſhe could come at it, kept her pockets full of it, and eat of it, to the ſame exceſs, that others are apt to eat ſweetmeats. The conſequence of which was, that ſhe was ſo dried up, her limbs ſo contracted and her joints ſo ſtiffened, that ſhe could not move them, and in this miſerable condition pined, and at length, ſtarved to death, at about thirteen years of age.

§ 124. In all ages, ſalt has been deemed to favor fecundity in the animal and vegetable creations. But, this is to be underſtood under the limitations before layed down. In both, it muſt prove injurious in exceſs; in either, ſerviceable in moderation, according as it may be adapted to the temperature of the ſoil or the ſubject.

§ 125. The exceſs of ſalt is the cauſe of the barrenneſs of ſeveral of the eaſtern deſerts; as about the dead ſea, ſo called not onely from its never being moved by tides, but from no animals being able to inhabit it; partly from its exceſs of bitumen, whence it is by ſome denominated the lake Aſphaltus, and partly from noxious exhalations; but chiefly, from the redundance of ſalt. The like ſterility is obſervable where ſalt and ſalt ſprings abound, every where. And to me, it ſeems probable, that the ſterility of Egypt, when the Nile does not overflow, is owing to a ſuperabundance of the nitre of the antients, which is never free from muriatic ſalt.

§ 126. All cold clayie and loamy ſoils may be rendered fertile by ſtrewing them with ſalt, which breaks and divides the tenacious earth and makes it ſuſceptible of other fertiliſing ſalts from the air. For this purpoſe, it is, that our farmers ſtrew lime on their

[a] Phil. of. Tranſ. N° viii. p. 138.

fields; which would be rendered much more effectual, if they threw ſalt, to the proportion of one third or one fourth, into their kilns, when at the higheſt heat and the lime almoſt burned. But, this by the by.

§ 127. With regard to the fecundity of animals, ſalt has always been looked upon as greatly conducive to this end. Whence, the name of ſalt has in various languages, as well as ours, furniſhed epithets for the paſſion of venery or a propenſity thereto; as ſalax, ſalacious, ſalt &c.

§ 128. The antient pagan mythologiſts, who, from the genealogies and attributes of their divinities, appear to have had very clear notions of nature, which could not well be obtained without the help of the chemic art; aſcribe the birth of Venus [a] to the ſea; which, from ſalt's having probably been firſt taken from thence, is called by VIRGIL [b] and other antient roman poets, ſal or ſalum. Hence, ſalt, the ſea, and Venus become figurative, ſynonymous terms for one another, and ſalt is by ſome of the antients looked upon as none immodeſt epithet for beauty or comelineſs of perſon.

§ 129. From their notion of the fecundating power of ſalt, it certainly was, that the antients deduced the origine of that divinity, which, with them, preſided over the rites of love, from ſalt or the ſea. And hence, they made their ſea gods, of all others, the moſt prolific. And ſuch have always been and now are all ſea animals in general obſerved.

§ 130. This notion however was carried to ſuch a pitch of extravagance, even by a writer, [c] whoſe authority was ſacred, before natural philoſophy reflected new light upon the world; that he, and ſome of his followers, brought themſelves and other like credu-

[a] Horat. lib. iii. Ode 26. lib. iv. Ode 11. Tibull. Elegiar. lib. i. 2. Ovid. Metamor. &c.

[b] Æneid. lib. 1. 2. 3. 5, &c.

[c] Ariſtotel. hiſt. anim. lib. vi. c. 37.

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lous men to aſſert and believe, that, by the eating of ſalt, certain animals, particularly mice, actually procreated without coition.

§ 131. PLUTARCH's notion of this matter is more rational: He obſerves, [a] that all cattle and dogs are rendered more prone to copulation and fit to breed, by ſalt. And, that for this reaſon, ſhips loaded with ſalt are more infeſted with mice, than any others.

§ 132. The ſame idea of ſalt abtained in Egypt, where thoſe, who devoted themſelves to lives of celibacy and chaſtity, ſo religiouſly abſtained from ſalt, as not to touch bread, in which the ſmalleſt portion of it had been mixed; looking upon it not onely as the great cauſe, but as if it were the very eſſence, of laſciviouſneſs. [b]

§ 133. This became one of the Canons of the Egyptian clergy: For, as Plutarch [c] informs us, the prieſts, when they led holy, chaſte lives, which ſeems hardly to have been at any time conſtantly the caſe; for, probably, it was with them, as with more modern ſects, but a ſort of mortification or penance; at theſe times of carnal abſtinence, we are told, thoſe antient holy men ſtrictly avoided ſalt in their food; for this among among other wiſe reaſons, that it ſharpened the appetite and excited heat and thirſt; by gratifying and ſlaking which, the body muſt have been too much nouriſhed, pampered and provoked to luſtful paſſions.—A leſſon, which might well deſerve the attention of modern prieſts and monks, if they did not chooſe rather to imitate their antient predceſſors in the craft, in their vices and follies, than in their virtues and wiſdom. The ſentiments of the laſt cited author are tranſcribed by Pierius [d] and by Agricola. [e]

§ 134. The ſame virtues are aſcribed to all medicated waters and baths, in which ſalt predominates

[a] Quaeſt. natur. 3. [b] Pierius, Hieroglyph. l. xxxi. § de nequitia. [c] Opuſ. de Iſide et Oſiride. Sympoſ. lib. v. Quaeſt. nat. x. [d] loco cit. [e] de natura foſſilium.

or abounds. Hence, ſuch, from earlieſt antiquity, have been deemed to cure ſterility in both ſexes, particularly in women. Conſult Baccius, Fallopius, Bauhinus and other writers upon the ſubject of baths and medicated waters. See the Eſſay on Aken waters.

§ 135. But, all this is to be underſtood within certain limitations: In extremes, the reverſe muſt always hold good: Too much ſalt muſt obſtruct the fecundity of vegetables, as well as of animals, at leſt equal, if not ſuperior, to its penury. The earth, where ſalt abounds, is ever barren; whereas, a moderate portion of ſalt contributes to fertility in general. Beſides, the ſeas, in which there is an infinitely greater proportion and variety of animals, than in any other water, are found much more plentifully ſtored with fiſhes in the colder regions, where the water is leſs ſalt, than in the hotter, where it is more ſaturated; but, where the waters are fully charged with ſalt; there, no fiſhes or other living animals are found; as in the Dead Sea, &c.

§ 136. Beſides, it is idle to lay it down as a certainty, that ſalt or any other medicine, produces this, or any other effect, in all caſes and times alike: The rules, layed down for its other medicinal uſes hold good in this; It will be found ſerviceable in cold, phlegmatic, imbecil conſtitutions; in lax fibres in general; but, the reverſe, in dry, hot, thin temperaments, where the humors are already too ſalt and ſharp; or in tenſe or criſp fibres in general. The ſeaſons of the year likewiſe make ſome difference in theſe caſes; as it is of an heating and drying quality, it will in general be found to produce ſtronger or weaker effects in all according to the heat or cold, dryneſs or moiſture of the ſeaſon and climate.

§ 137. Let no perſon, that reads this tract, be ignorant of the difference between ſalted meats, and ſalt eaten with freſh meats. The meats preſerved in ſalt, are extremely hardened, in which the curing them conſiſts. This renders them hard of digeſtion. Beſides,

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all ſuch generally undergo ſome degree of putrefaction, of which the redneſs of the ſurface of ſuch fleſh is an evident proof. In this, the meat and the ſalt ſuffer a conſiderable change, which by no means happens, when a moderate portion of ſalt is taken with freſh food. It helps digeſtion and reſiſts putrefaction.

§ 138. It is obſervable, I have here throughout layed the principal ſtreſs on conſidering the qualities of ſalt; becauſe I look upon ſalt waters in general, whether of ſprings or of the ſea, to be but ſolutions of this ſalt of different degrees of ſaturation, and with ſome accidental varieties. From the proportion of ſalt, the doſes of the water is to be generally aſcertained. Then, ſome regard is always to be had to the proportion of calcarious ſalt, ley or bittern, the water yields; ſince, it is chiefly from this, the bitter, purging ſalt is produced. In the ſtrongeſt impregnation, there is always leſt bittern to be found. Thus, in the ſtrongeſt brine of Upwich at Droitwich, which is ſayed to contain and yield one fourth pure ſalt, no bittern is obſerved. Whereas, in all the weaker impregnations in other ſprings, in ſolutions of rock ſalt, as alſo in the ſea, more or leſs bittern is always found; partly becauſe, by ſuffering the greater and longer action of the fire to evaporate the ſuperabundant humidity, they muſt ſuffer a greater decompoſition. The waters of the ſea, having, from the air and the ſun, ſuffered more of this decompoſition, than thoſe waters, which in the bowels of the earth are leſs liable to ſuch effects; generally ſhew more of this bittern, than any others. They alſo imbibe more of the oily matter from the air; and perhaps, they may alſo be more charged with a calcarious earth, than moſt others.

§ 139. A more rational idea of this matter may beſt be conceived from the following experiments;

§ 140. 1. If four equal portions of equally pure ſalt gem be taken, and then diſſolved, the 1. in double its weight, or a little more, of deſtilled water; the

2. in ten times its weight of the ſame deſtilled water; the 3. in a ſufficient quantity of pump water; and the 4. in a like portion of lime water: Upon evaporating theſe clear ſolutions in an equal heat; the reſult will be, from the 1. a fair cubico-pyramidal ſalt, without any bittern, from the 2. the like ſalt in ſmaller cryſtals, with ſome bittern; from a decompoſition, by the longer action of the fire; from the 3. larger cryſtals of the ſame ſalt, with a terrene ſcum or precipitate, and ſome bittern; more or leſs, according to the terreſtreity or purity of the water; and from the 4. a ſalt like the third, with a terrene ſeparation, and a very conſiderable quantity of the calcarious ſalt, ley or bittern, from the impregnation of the lime water.

§ 141. Theſe ſhew, 1. how ſolutions of ſalt in the ſame water are altered by fire; though before that action, they differed onely in degrees of ſtrength; 2. how ſuch ſolutions are altered according to the nature of the water, and that the ley or bittern in all, is but a ſolution of a calcarious earth in the acid of ſalt.

§ 142. Hence, I look upon all ſalt waters to differ onely by theſe, or ſuch like, accidents; and that the particular difference being known, the judicious phyſician can then, and then onely, properly preſcribe and direct the uſe of the medicated water, as of any other remedy.

§ 143. Salt in a dry or liquid form reſtrains and conſumes excreſcences, even of the warty or corny kind, by long and frequent application. Anaſarcous and oedematous tumors, partial or univerſal, are reduced by lying and ſweating in hot ſalt. Acute muſcular pains, that give way to none other application, are aſſuaged by the ſame application. Thus, painful ſwellings of the tonſils, and baſtard quinzies, may be relieved. The moſt convenient form is putting the dry heated ſalt into a thin bag of any convenient ſize and form, and laying it to the affected part, as hot as may be agreeably borne.

§ 144. Our ſalt ſprings are differently impregnated. Some ſo ſtrong as to be unfit for moſt external, as well as external uſes, as thoſe of Northwich and Droitwich, &c. Others more weak, as thoſe of Nantwich, &c. But, all requiring ſome dilution to render them tolerable agreeable to the ſtomach. In Lancaſhire, ſome are near the ſtrength of the ſea; as in the ſpring of Alderman CLEGG's baths, in Liverpool. The mildneſs, as well as efficacy, of the operation of this and other ſalts depends upon its dilution: For, a drachm of any ſuch ſalt will operate more blandly, and at the ſame time more powerfully, when taken diſſolved in a pint of water, than four times that quantity in one fourth of that proportion of water.

§ 145. It is chiefly upon account of this dilution, but partly for the greater proportion of calcarious earth, it contains, that I think the ſea water preferable, for moſt medicinal purpoſes, to our mediterranean ſprings, or to any arteficial ſolution of ſalt in common water.

§ 146. The ſtrength of the ſaturation of the ſea differs not very remarkably upon the coaſts of our iſles, as far as I can learn. The varieties, that appear, depend upon the quantity of freſh waters diſcharged into the ſea from great rivers. The changes wrought by ſprings in the ſea, or by the leſs conſiderable rivers, are not eaſily perceptible. The leſs freſh water is by any means mixed with the ſea, the ſalter it muſt neceſſarily be. And on the contrary, at, or near the mouths of rivers, it muſt always be found more dilute; as it muſt likewiſe be in wet weather. Hence, it muſt be more ſalt in general, in ſummer, than in winter.

§ 147. The ſea is ſalter at the bottom, than at the ſurface; except, where, by ſubterranean rivers or ſprings diſemboguing themſelves into it, the caſe has been altered. The reaſon of this is obvious; the ſaline being the heavieſt particles, preponderate.

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Whileſt freſh water being lighter, lyes on the ſurface for a while unmixed with the ſalt. This, in very calm weather, is even viſible at the mouths of great rivers, and is palpable upon trial.

§ 148. The principal differences, that ariſe beſides are ſeen at the different times of the flux and reflux of the ſea. If none other accidents intervene, it is always found more ſalt in the higher, more dilute in the lower tides. But, I could never find this variety excede a few grains in a pint, from the ſpring to the neap tide. I alſo find our ſeas, about our eaſtern, ſouthern and weſtern coaſts, contain from about four, to five and an half, or ſix drachms of ſolid contents in the pint; ſo that the medium may be placed at about five drachms, in general; but rather under than over this quantity.

§ 149. Of this proportion of ſolid parts, from eight to ten grains appear to be a calcarious earth, which muſt be ſeparated before the ſalt cryſtaliſes; elſe it impedes the operation. It is by the halurgiſts, or workers in ſalt, called ſcum, from its being in this form taken off the ſalt pans and rejected.

§ 150. Where neither this terrene mixture, nor that of the calcarious ſalt are judged proper; there, a ſolution of the intended quantity of pure ſalt in fair water, may be given. But, where theſe earths, which render the liquor, that contains them, more aperient, deterſive and diuretic is neceſſary, there the ſalt water of the ſea had better be given; remembering the proportion it contains, ſo as thence to aſcertain the doſe.

§ 151. Salt in all caſes, in which it is found proper, upon the principles here layed down, may be taken to the quantity of four or ſix drachms, thus diluted, in the compaſs of a natural day. Yea, ſome may require the inlarging the doſe to eight or ten drachms.

§ 152. Where it does not excite an unnatural heat and thirſt, but kindly promotes the excretions by the alvine

alvine and urinary emunctories, it will be found to produce its beſt effects. If theſe complaints ſhould ariſe, plentiful dilution with ſoft, fat, light broths, or even with fair water, muſt be interpoſed, and the quantity of the ſalt water diminiſhed or totally layed aſide.

§ 153. Proper ſubjects ſhould enter upon a courſe of ſea water, after gently emptying the firſt paſſages, with caſſia, manna or ſome ſuch lenient purge; with a ſmall quantity of which, or with any of the neuter purging ſalts, or magneſia alba, the bowels are to be kept ſoluble and cool.

§ 154. As the doſe depends upon the patient's ſtrength and habit of body, upon the ſtate of the bowels and the nature of their contents; the beſt way of determining it is, by beginning early in the morning with ſmall quantities, ſuch as two or four ounces, repeting it once an hour or two, for two or three times, increaſing or decreaſing the quantity, as it may prove to agree or diſagree; increaſing it gradually, if it anſwers, as far as a pint, a pint and an half, or a quart, a day; dividing it between the three medicinal ſeaſons or times of the day, morning, noon and evening, the hours when the ſtomach is moſt empty; decreaſing it in the like proportion; and, if it diſagrees, diluting it with ſimple water, or ſheathing the parts from its acrimony by broths or oils; till it becomes familiar to the oeconomy.

§ 155. It is impoſſible to determine the length of time neceſſary to purſue the courſe. Some conſtitutions and caſes require leſs and others more to anſwer the deſired end: With ſome likewiſe it will agree warm, to whom it may prove offenſive cold; and ſo the reverſe. Theſe and much more muſt be left to the immediate direction of the attendant phyſician.

§ 156. Our country people know the uſe of ſalt or ſea water in many inſtances: They give it ſometimes with ſucceſs to ſtop vomitings and to determine the motion downwards. In this intention, it is likewiſe

wiſe known to ſea-faring folk. With moſt ruſtics, it is given to eaſe the cholic pains and other uneaſineſſes of the bowels of children, ſuppoſed to ariſe from worms. And I have not been able to learn any evil effects from even theſe injudicious applications.

§ 157. The external is no leſs efficacious, than the internal uſe of ſalt water. A great variety of erruptions and foulneſſes of the ſkin are relieved by waſhing or bathing in the ſea water.

§ 158. It is to be looked upon, as a medicated cold bath, whoſe operation does not ſo much depend upon its coldneſs, which muſt not be computed from that ariſing upon the diſſolving ſalt in water; this effect is but momentaneous: For, ſoon after the utmoſt cold is thus produced, the ſolution begins to receive the impreſſion of the incumbent atmoſphere, and thence to borrow its heat or cold ſolely. Hence, the ſea is not properly to be deemed a cold bath. In this manner of application, its action is to be accounted for, from the efficacy of the ſalt, as a topical application, and from its increaſing the gravity of the water.

§ 159. HIPPOCRATES[a], in moſt caſes, prefers it hot to cold. It may ſeem like holding a candle to the ſun to offer arguments to ſupport ſo great an authority. Moreover, the reaſon of the preference muſt be evident to all, that conſider what has been ſayed of the efficacy of ſimple water[b], and of the virtues of ſalt[c].

§ 160. Its efficacy in contractions of the joints and indurated, indolent tumors, is greatly increaſed by pumping or letting a current of the water fall from the height of ſome feet upon the part affected. But, for this purpoſe alſo, it is rendered moſt effectual by heating to a moderate degree, I mean the degree of human blood in the healthful ſtate.

[a] De humid. uſu. ſect. vii.——Praeſtat ad plurima calida.
[b] P. I. § 371. and following. [c] § 86 and following.

§ 161.

§ 161. In oedamatous, anaſarcous and hydropical caſes, as well as in certain paralytic affections, the vapor of heated ſea water is a moſt potent remedy; upon principles before explaned [a].

§ 162. Since then the bountiful creator has thus plentifully provided for all emergencies, making all the elements miniſter to our wants; ſince the extended main makes but a part of the happy dominions of Britain; let us not fail of cultivating and ſecuring the bleſſing, in any inſtance. Let us furniſh our coaſts with conveniencies for uſing this powerful and extenſive remedy, externally and internally. Let us in every ſenſe be mindful of the numberleſs bleſſings poured down upon us, and embrace them wiſely and thankfully; and eſpecially that, which conſtitutes our chief happineſs; that the ſame element, by whoſe means we are ſupplied with the commodities of other nations, in higher perfection than their natives enjoy them, giving us all the advantages, without any of the diſadvantages, of the different extremes of climates betwixt the poles; that the ocean, which makes the power and fame of Britain, objects of terror, admiration and envy to the reſt of the globe; while it extends her dominions, brings wealth to her coffers and health to her ſons!

§ 163. How all our coaſts are attended to in the medicinal intention, I can not ſay. But, in moſt, that I have heard of, there is but little improvement beyond the ſtate of nature, few or no real conveniencies provided for either drinking or bathing. In all places, in which there are lodgings and other ordinary accommodations, and which are frequented for the uſe of bathing or drinking, there ſhould be means of conveying the water to fit places at the ſhore, at all times of the tide, to furniſh bathers and drinkers of the water commodiouſly. This may be done by conveying pipes from under the level of the low water to the ſhore; where baths and rooms ſhould be erected, in which the water may be applied, whether

[a] P. I. § 591. 2. and following.

in-

internally or externally, without being expoſed to the changes and inclemencies of weather, or to public view. Thus likewiſe, the water may be obtained for all purpoſes in the higheſt perfection; whereas, when it is taken from the ſurface, it is never to be found conſtantly of the ſame temperature or ſtrength; being varied by the heat of the ſun and air, by rains, &c; when a few feet lower, it remanes quite unaffected.

§ 164. Thus, we may be ſtrictly decent and elegant, as well as phyſically juſt in our oeconomy; neither of which can we be, when we bathe promiſcuouſly, though covered or at a diſtance, in the ſurface of the open ſea; whoſe place is conſtantly varying with the tides, as its temperature and ſtrength depend upon the heat of the air and its dryneſs; which therefore can never be leſs variable or indeterminate.

§ 165. In our ſea baths we ſhould not onely be thus furniſhed with cold ſea water in various chambers for the different purpoſes of cold bathing, whether for univerſal immerſion or partial embrocation; by pumps, &c; but, we ſhould alſo have it heated for all the ſame purpoſes, as alſo for vapor baths, in which manner it is found in many caſes moſt efficacious.

§ 166. The ingenious Mr. DAVIES of Harwich, to whom the public in general, the inhabitants and ſojourners of this town in particular, are in many inſtances obliged, has contrived baths here, which for their convenience and elegance may ſerve for a pattern to the reſt of the kingdom. There is a neat building, which contains baths and dreſſing-rooms, with all the neceſſary conveniencies, for both ſexes, without having any ſort of view of, or intercourſe with, one another. The baths are furniſhed with a reſervoir, which ſupplies them, as by a ſpring, from the bottom of each bath; ſo that by making them thence overflow, as may be done, during the time of bathing,

ing; all filthineſs, that comes from the ſkin, may be immediately carried off. And here, water is raiſed by a curious machine in ſuch a manner, as not onely to be ſuffered to fall from the heighth of eight or ten feet, but to be thrown in any direction, and with any degree of force, required, upon any part of the body. This is done by forcing the water into a large metallic ſphere, from the lower part of which iſſue one or more flexible tubes of leather, with openings of different makes and ſizes adapted to different parts of the body. By theſe, the water may be made to fall, by its own proper gravity, in ſtreams of any ſize required, upon any part of the body; while, by cloſing a cock at the upper part of the ſphere, the force of the falling water may be increaſed to the utmoſt pitch tolerable, by the ſpring of the included, compreſſed air.

§ 167. As this ingenious gentleman has furniſhed me with a drawing of theſe baths, I think it proper to have it engraved, and to inſert it for the ſatisfaction of the public. He has judiciouſly taken the advantage of a piece of ground, near the ſea coaſt, which is ſeveral feet lower, than the high water mark. Here, he erected his buildings for his baths; where he had on one ſide a ſufficient reſervoir, ſo conſtructed, as at every tide to receive and contain ſeveral hundred tuns of the ſea water, in the utmoſt ſtrength and purity, to be admitted into the baths, in ſuch proportion and manner, as may be required.

§ 168. The water is conveyed into the reſervoir every tide by an aqueduct under ground, of one hundred and ninety-two feet in length and ten inches ſquare. At the end of this aqueduct next the ſea, a double valved ſluice is placed of a ſingular conſtructure, calculated to let in the water of the tide, free from looſe ſand and ſuch like impurities, and to let out the water remaning after the baths are ſupplied, at low water, in order to readmit a new ſupply from the returning tide.

§ 169.

§ 169. Of this machine, three different views are given in figure II, III, IV. It conſiſts of a ſquare horizontal trunk, A, with a ſluice or valve hanging perpendicular, by hinges at the upper ſide of the trunk, b, b, b. This valve opens, when the tide runs out, and thus diſcharges all the water, which remanes in the reſervoir, after the baths are ſerved. And, upon the return of the tide, ſhuts cloſe, as in Fig. III. B. and prevents the entrance of foul water, with looſe ſand, mud or the like.

§ 170. To admit water perfectly clear, as well as ſtronger than the firſt flowings, the upright ſluice, C, with an horizontal valve is contrived. This valve, when ſhut, is expreſſed in Figure IV, at E. But, being attached to a lever, 1, 2, 3, Fig. II. III. IV. at one end of which an hollow copper ſphere, 4, 5, 6, is fixed; when the tide riſes high enough to float the copper ſphere, this valve opens and ſtands as in Figure III. D. and ſo admits the pureſt and ſtrongeſt water.

§ 171. Thus the reſervoir T, is furniſhed every tide with water more than ſufficient for the baths; the remainder of which is diſcharged at the ebb, before the refluent tide, by the ſame canal, through which it entered, Fig. II, IV, a, a.

§ 172. The Baths ſtand in the middle of the reſervoir; and are acceſſible onely by the means of the bridge, N. The building, of which a perſpective ſection is exhibited, Fig. I. U, U, U, U; conſiſts of an antichamber, O, where the bathers meet and wait to take their turns in the dreſſing rooms and baths, of which there are two, P and Q, Q, appointed for the different ſexes; one of theſe baths is furniſhed with a crane-chair, for the immerſion of ſuch as may not be able, and ſuch as are to be compelled, to go into the bath.

§ 173. Each of the dreſſing rooms, P, communicates with its own bath Q, onely. And each bath is fur-

A Perspective Section of the RESERVOIR *and* Sea Water Baths *at* HARWICH *in the County of* ESSEX.

Pl. I. *Part II p. 89.*

Fig. I.

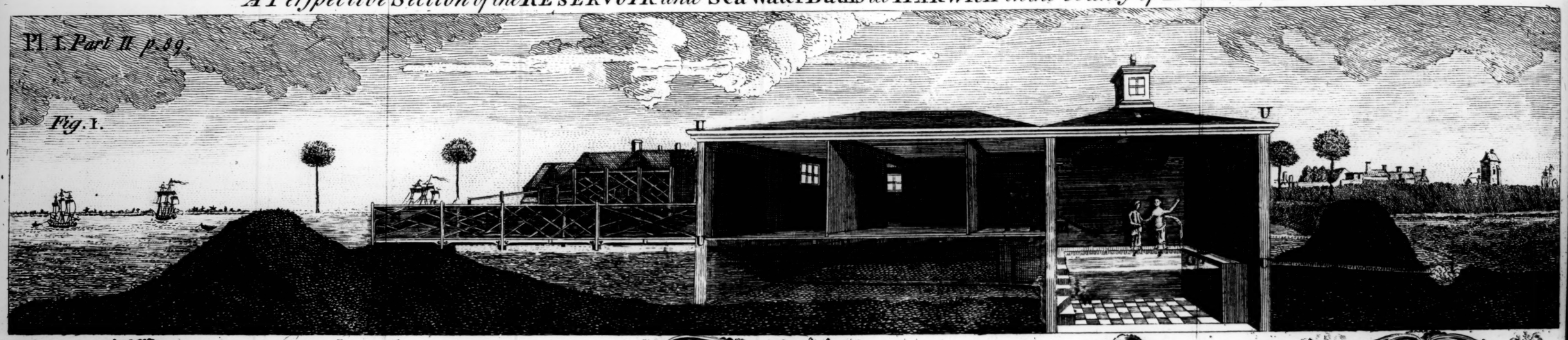

Fig. II.

Cui Gratias et Amoenitates
Omnium Venerum, Venustatum atque Virtutum —

Fig. III.

Fig. IV.

This Plate, with the most exquisite Affection, & most profound Respect, is Inscribed,
To the Honorable Miss Talbot

furniſhed with water from the reſervoir by the means of a pipe conveyed from the reſervoir to the bottom of the bath. This pipe is furniſhed with a cock, F, upon the opening of which the bath is filled in a few minutes to the requiſite highth, at which there is an opening, G, to prevent its riſing higher than four feet and an half, ordinarily; though by a ſluice, V, this opening may be cloſed, and the bath filled to the level of the reſervoir. This contrivance has ſeveral obvious advantages, the chief of which ariſe from the waters ſpringing in at the bottom, W, during the bathing time; by which a conſtant current of new water is brought in; while all impurities are helped to riſe to the ſurface, from whence they neceſſarily run off at the opening, G, and with the redundant water, are carried off by the ſewer, H, into the marſh, I; where they remane till the ebb, when they are by another ſewer diſcharged into the ſea.

§ 174. In a little room between the dreſſing room, P, and the bath, Q, an Engine, K, is placed, which ſerves various purpoſes: By means of a forcing pump furniſhed with four different pipes of ſuction, occaſionally communicating with the reſervoir, with either bath, and with a veſſel of ſea water heated to any degree required; 1. the ſea water is thrown in any direction, and with any force or velocity required, upon any part of the body: For, the water being forced into an hollow copper ſphere, L, may be diſcharged by its own gravity, or the utmoſt preſſure of compreſſed air, by the cock, M, furniſhed with a flexible tube and heads of different forms and ſizes, for applying the water cold or warm to any part of the body, as in the figures 1, 2, in the bath. This excedes any method of pumping hitherto known. 2. After all the water in the reſervoir and bath, to the level of the bottom of the reſervoir, are diſcharged by the common Aqueduct, Fig. II. A, A, a, a, the water remaning in the bath is pumped out by this machine, ſo as to be with the reſt diſcharged.

§ 175. Mr. DAVIES, determined to ſpare no pains or expence requiſite to make theſe baths complete and moſt extenſively uſeful and beneficial to the public; promiſes to erect, contiguous to theſe, a furnace with a large caldron to heat water, and fit warm dreſſing chambers, with chairs and other conveniencies for Vapor baths, in order to have warm ſea water baths for all the purpoſes upon the ſame plan with theſe.

§ 176. The efficacy of ſuch baths and ſuch embrocations, both cold and warm, muſt be readily ſeen, by conſidering what has been already ſayed upon this kind of bathing, in treating of ſimple bathing. And hence we may form an idea of the great convenience, elegance and utility of the HARWICH SEA BATHS, ſee what we owe, in this inſtance, to the ingenuity of this worthy gentleman, and judge how his example merits general imitation.

§ 177. I can not properly cloſe this head without obſerving, that the next in convenience and elegance to the Harwich baths, that have as yet come to my knowledge, are thoſe erected by that moſt public ſpirited, loyal and worthy magiſtrate, Alderman CLEGG of Liverpool; who after contributing every thing in his power to the inriching, extending and beautifying that famed mart and moſt loyal corporate town, and that in every ſtation, from that of a private citizen, to that of chief magiſtrate; has ſince taken all poſſible care of the health of the community, by erecting moſt commodious and elegant cold and hot baths, furniſhed with excellent ſalt water, either from the ſea or from a pure ſalt ſpring; of either of which, he has a proper command, for all the medicinal intentions, whether internal or external.

§ 178. It will probably be expected, that I ſhould nor diſmiſs this ſubject without ſaying ſomething on that, that has long engaged the heads and pens of many ingenious men to very little purpoſe; I mean the diveſting ſalt or ſea water ſo perfectly of its ſaltneſs, as to render it completely ſweet.

§ 1

§ 179. Many and various, but vane and fruitleſs have been the attempts in this way. And it is much to be lamented, that by all the efforts made, the proſpect of ſucceding is not yet much mended. What moſt ſeem to have aimed at is the ſeparating the entire ſalt from the water in its natural concrete form, or giving the acid a baſe, that ſhould retain it more firmly, than the mineral alcali does. For this purpoſe, ſome propoſed congelation, in which the ſalt is parted from the froſen water or ice, which can onely ſuccede in extreme cold weather, and therefore can never be of general uſe. Some have imagined, that ſuch a ſeparation might be wrought by different kinds of ſtraining. For this purpoſe, whimſical brains have deviſed various methods, which they ſurely had never committed to writing, had they but made trial of them. Among theſe, the moſt ridiculous is an hollow ſphere, or other veſſel of wax, which being immerged, or otherwiſe ſet, for ſome days in the ſea, is conceived, not proved, to let ſweet water tranſude. The next is the notion of a veſſel made of black poplar, which is ſayed to let the ſweet water ſtrain through its pores and exclude the ſalt. The third is, that of making ſalt water paſs through ſeveral layers of ſand, in which, it is ſayed to depoſite its ſaltneſs. Theſe are all too abſurd to admit of a ſerious confutation. So comminuted are the particles of ſalt in ſolution, that we know no ſtrainers in art or nature, through which the one can paſs, without the other. Thus, in all the juices of an animal body, common ſalt may be found hardly altered. And the kidnies, whoſe ſubtil ſtrainers let not a globule of blood or a particle of lymph paſs through them, admit urine ſtrongly charged with ſalt freely to pervade their moſt fine, minute tubes. What contrivance of human invention can be ſuppoſed equal to this maſter-piece of unerring nature!—None certainly. How are we then to look for the ſeparation of ſalt from water by any modes of ſtraining?

§ 180. Some recommend ſuch bodies, as might unite ſo firmly with the acid, as to let the water fly off free from any acid taint. For this purpoſe, various ſubſtances have been tried. Among the firſt were zinc or calamine[a]; but, as theſe attract the vitriolic or any other acid, and as the calamine is ſeldm free from a martial earth or vitriol, they can but ill anſwer the intention.

§ 181. Some recommend Muſcovy glaſs[b]. This, or any of the gypſe or plaſter of Paris kind, being ignited and caſt into ſalt water, is ſayed to attract and ſeparate the ſalt.

§ 182. Some have thought of ſuch metallic calces or ſolutions, as ſtrongly attract, and are attracted by, the acid of ſea ſalt; particularly lead and its preparations. Thus, any ſolution of this metal in a vegetable acid eſpecially, being dropped into ſalt water, a double decompoſition is produced; the acid of ſalt ſeiſes and arreſts the particles of diſſolved lead, and uniting aggregate and precipitate them. This, quickſilver diſſolved in the acid of nitre alſo does. So alſo does ſilver. By theſe means, it is true, the water loſes its ſaltneſs, as its acid unites with another body, which ſeparates and precipitates. But, the two former precipitates are again ſoluble in the water; nor is it ever to be ſo perfectly freed from any of theſe metallic ſolutions, as to be fit for any internal uſe.

§ 183. All theſe methods being found ineffectual, recourſe at length was had to deſtillation, which ſeemed to promiſe greater ſucceſs. But, this was not found to anſwer; for, from the extreme volatility of the acid of ſalt, which, probably aroſe from the ſubtilty of its mercurial principle, ſome portion of it was always found to tranſcend the helm, and render the water leſs ſalt, indeed, by much, than before; yet notwithſtanding, unfit for the principal purpoſes of pure water: For, this deſtilled water is incapable of ſlaking thirſt, and dropped into the eye, it gives a ſenſe of pain; which ſhews it not quite clear of ſaltneſs.

[a] Leibnitz Act. erud. Lepſ. [b] Glauber.

§ 184. Various ſchemes of reſtraining this volatility have at length been contrived and propoſed to the public, to our royal ſociety, admiralty, or navy board, and obtained ſome degree af approbation; for reaſons which, I muſt confeſs, as yet ſeem to ſurpaſs the ſcope of my conception. Theſe have been done upon the principle of giving this volatile acid a baſe, to which it ſhould ſo firmly unite, as to ſtand unmoved by the degree of fire neceſſary to propel the aqueous humidity in deſtillation. Thus, ſome added a fixed alcaline ſalt, with or without ſand or clay, and then deſtilled the mixture. Others propoſed the mineral alcali and earth of the ſalt water to be firſt precipitated with an alcaline ley, either ſimply vegetable, or with the addition of lime, then deſtilled, and afterwards filtrated through a certain argillaceous earth. Some direct the mixing of ſea water with ſuch earths onely and deſtilling them; whileſt others direct the uſe of crude tartar, to anſwer none intention, that I can at preſent conceive, and perhaps, for no better reaſon, than that for uſing the before-mentioned earths, with whom the common artiſans, that uſe tartar, confound it, calling both, indiſcriminately and ſtupidly, argil. A later propoſer of dulcifying ſea water uſes the ſtrongeſt fixed alcaline cauſtic, and thinks, he made a moſt happy diſcovery in adding calcined bones, which in mine apprehenſion, can anſwer no better purpoſe, than the preceding earths.

§ 185. Theſe various methods were propoſed, chiefly to ſupply the want of freſh water at ſea, and have, in their turns, met with ſome approbation. The onely rational project is that with a fixed vegetable alcali. But, even this is found as yet but incomplete. And had it been ever ſo effectual, what uſeful purpoſe could it be ſuppoſed to anſwer, when a large deſtilling apparatus and ſuch a conſiderable ſtore of fewel is neceſſary to ſerve a ſmall ſhip's crew, as would leave but little room for the ſtowage of goods and other neceſſaries.

The End of the ESSAY on SALT and SEA WATERS.

SECTION III.

Of SALINE WATERS *in general.*

§ 1. THIS is an extenſive claſs, as it may take in a great variety of waters alcaline, muriatic and neuter. I ſhall at preſent confine myſelf to the laſt. Of theſe, our country affords great plenty and ſome ſmall variety; conſiſting of the vitriolic acid ſaturated with different earthy matters; chiefly the baſis of ſea ſalt, and ſome, with theſe, are ſlightly impregnated with iron. I ſhall at preſent give two examples of this ſort of water, 1. in that of EPSOM, and 2. that of CHELTENHAM.

1. Of

I. *Of ſimple neutral, purging* WATERS.

Of EPSOM WATER.

Inſcribed
To his learned and much admired
Friend,
Doctor WILLIAM BAYLIES,
Phyſician at BATH;
As a public teſtimony
Of the well-merited Eſteem and Affection
Of the Author.

§ 2. EPSOM is a very large and conſiderable village in the County of Surry, ſeventeen miles ſouthward of London. In the middle of an open, rude common, on the decline of a riſing ground, in a ſouth expoſure, about a mile from the village, ſtands a ſpring, of which, I could not now get ſight; becauſe it is covered with a building and has a pump ſet in the ſource for raiſing the water. As this is the firſt water in our country, that was found to yield a purging bitter ſalt; it gave its name, not onely to the ſalt of its own water, but to a ſimilar ſalt extracted from any other water, or even that from bittern; and that, whether prepared at our ſalt works here in Britain, or in Germany [a]; I ſhall give it its deſerved place here; aſſured that, however neglected from our preſent love of novelty, it is equal, if not ſuperior, to ſuch as now attract the public attention, filling our news-papers with noiſy, idle and ill-conducted controverſies.

§ 3. Epſom water is colorleſs and pellucid; ſcentleſs, and hardly ſapid. Common palates might miſ-

[a] Hoffm. de fonte & ſale ſedlicenſi.

take it for ſimple water; but the more experienced find a ſlight ſaline taſte, ſuch as the common purging bitter ſalt, diluted in common water of the like ſtrength, imprints.

§ 4. It ſuffers no change by carriage or keeping in London for ſome months; provided the bottles and corks be new and clean; otherwiſe, it will putrify and ſtink in a ſhort time; as the ſea and other ſalt and ſimple waters will do.

§ 5. 1. The phial, which, filled with deſtilled water of the ſame temperature, weighed two ounces, ſix drachms and twelve grains; with this, weighed four ounces, ſix drachms and ſeventeen grains and an half.

§ 6. 2. With ſirup of violets, a tea ſpoonful to two ounces of the water, it gives a ſea green, ſoon after mixture, and changes to a graſs green in a few minutes.

§ 7. 3. With Infuſion of Campechy wood, twenty drops, a pale, pink-bloom color.

§ 8. 4. With Infuſion of Galls, to twenty drops; it ſuffers no ſenſible change at mixture; but, in a few minutes, grows milky at the ſurface, and throws up a pale mother of pearl colored pellicle, and upon ſtanding ſome hours becomes blewiſh firſt and then of a greeniſh yellow.

§ 9. 5. With ſtrong ſpirit of ſal ammoniac, ten drops, it cauſes no commotion; but grows milky, to a pearl colored opacity; which ſoon after coaleſced into clouds, and lightly precipitated, in ſmall quantity.

§ 10. 6. With alcaline ley, ten drops, a ſimilar effect, rather more powerful is produced, without any viſible commotion. In about half an hour it coagulated into clouds, which in time ſlowly precipitated, in greater abundance.

§ 11. 7. With the vegetable acids, no perceptible commotion: yet, there were many air bubbles adherent to the glaſs, after it ſtood a while, which ſeemed to argue a contraſt.

§ 12. 8. With the vitriolic and other mineral acids diluted,

diluted, no commotion, that could be looked upon as an ebullition from the contraſt betwixt acids and alcalies. Yet, after ſtanding, there were ſome few ſmall air bubbles adherent to the glaſs, that prompted a ſuſpicion of ſuch a contraſt, ariſing probably from an heavier acid attacking the abſorbent earth diſſolved in a lighter acid; which in the conflict may be partly propelled or ſet at liberty.

§ 13. 9. With the ſolution of lead, five drops; at every drop, it gave a bright, ſnow-white cloud; and being all ſtirred, it became of a ſnowy opacity all over. Then, a fair, ſubtil, white precipitate gradually ſubſided.

§ 14. 10. With the ſolution of ſilver, to five drops; at every drop, a bright, blewiſh milky cloud; upon ſtirring, all over of a pearl colored opacity; which ſlowly ſubſiding, gave firſt a white, changing to a ſlate colored, precipitate.

§ 15. 11. With the ſolution of corroſive ſublimate, as far as twelve drops; no ſenſible change upon dropping or mixing. Upon ſtanding, a pellicle of a pale mother of pearl color roſe and covered the ſurface; and ſoon after, it appeared ſlightly milky and coated the glaſs all over.

§ 16. 12. With the ſolution of quickſilver in the acid of nitre, as far as five drops; every drop cauſed a milky cloud, which inſtantly changed to a deep lemon or turpeth mineral color, and as ſuddenly precipitated; leaving a light, pale, pearl colored pellicle on the ſurface.

§ 17. 13. It coagulates a ſolution of ſope. And,

§ 18. 14. In any proportion above equal parts, boiled with milk, it curdles effectually.

§ 19. Theſe ſeveral experiments, from 2 to 12, which anſwer equally well in London, as at the well; all give evident indications of a water, by the means of the univerſal or vitriolic acid, charged to a neutrality with the alcaline baſis of foſſil ſalt and ſome abſorbent

bent or calcarious earth. While 7, 8, 11, give indications of ſome alcaline matter.

§ 20. Theſe may be proved in the inverſe method, by thus ſaturating the vitriolic acid, with the mineral alcali and ſome abſorbent earth, and charging any water with it to the ſame proportion, as is found in the natural; or diſſolving Glauber's ſalt in any terrene water; ſuch as that of moſt pumps is found; to the like ſtandard; all to the alcaline matter, which art can hardly emulate.

§ 21. This is further evinced by evaporation to a dryneſs; which gives us the ſolid, fixed contents of the water, in the groſs. Theſe are fourty grains in the pint.

§ 22. Pure deſtilled water being poured upon this reſiduum readily diſſolves the ſalt, and leaves the earth, in the proportion of one ſixth of the whole, behind. The ſolution, being evaporated to a pellicle, gives a ſalt, whoſe cryſtals in figure, as well as qualities, correſpond with thoſe of Glauber's ſalt; leaving ſome bittern, that will not cryſtalliſe. Or, being evaporated to a dryneſs, the quantity of ſalt, which remanes, and is about thirty three grains in a pint, is determined.

§ 23. Each pint then of this water, which contains this proportion of theſe fixed, ſolid contents, according to this method of trial, affords of a calcarious earth, which ſhews itſelf by ſeparating in the evaporation, ſix grains. Though this may be, in ſome meaſure, a decompoſition of the natural ſalt, diſſolved in the water. The portion of ſalt left in this quantity being about thirty three grains.

§ 24. Theſe ſolid contents, as the maſs is obtained, in the groſs, by evaporation, give indications, not onely of the vitriolic acid, ſaturated with the mineral alcali, the baſis of marine ſalt [a]; but of its containing ſome portion of the muriatic acid, charged with calcarious earth, the muriatic ley or bittern, with

[a] § 9.

the

the oily matter common to all waters: For, the reſiduum [b] of a pint of the water expoſed to the open air, for about eighteen hours, increaſed in weight about twenty grains, by its bittern's imbibing ſo much of the humidity of the atmoſphere. The oily matter is diſcoverable in the color of the ſolution, when freed of earth by filtration and deprived of ſix eighths of its humidity; 2. In that of the ſalt evaporated to a dryneſs; 3. In its fuming, when thrown upon an ignited iron; and 4. in its coloring alcohol yellow. This ſhews the difference between taking the water in the natural ſtate, a perfect mixture and a complete ſolution of the aggregate; and taking the ingredients apart, ſeparated by art.

§ 25. The ſalt of this water and others of the like nature is a native mineral bitter ſalt compoſed of the acid or acids, with which the water is charged, and the baſis of ſea ſalt, more or leſs free from other terrene bodies. The earth is partly inſoluble in the acid of ſalt; and therefore is partly a ſelenite.

§ 26. Some, who vaunt in their imaginary knowledge in the chemic art, condemn the inventers of the common purging bitter ſalt of the ſhops, for ſupplying us with ſuch an unnatural ſubſtitute. But, ſure ſuch men had deſerved our thanks, had they made and given the world this diſcovery from motives purely public ſpirited and benevolent; ſince, the natural ſalt of Epſom waters, and thoſe, that have uſurped the name, are by no convincing experiment to be diſtinguiſhed the one from the other; no more than they are from other native or artificial ſalts, upon the ſame principles, when perfectly pure.

§ 27. As then it is found, that all the purging waters known, as thoſe of Sedlitz in Bohemia, as well as thoſe of Britain and other countries, correſpond in ſenſible and eſſential qualities with the artificial ſalts made by ſaturating the vitriolic acid with the mineral alcali or alcaline earths, as that of our bittern or that of

[b] § 20.

Glaub-

Glauber; and as theſe ſalts have been idly deemed nitrous by many writers and practicioners, and are the Nitrum calcarium of our LISTER; I ſhall here, once for all, ſet down the characteriſtics of this native ſalt, which may be called the Univerſal Vitriolic, or Native Vitriolate ſalt, for diſtinction ſake; as ſea ſalt and Nitre are denominated from their acids, not from their ſolid baſes, whether mineral or vegetable; and as the appellation of nitre, whether antient or modern be meaned, is not ſuitable to it, and that of calcarious nitre can onely ſuit natural immature, modern nitre or ſalt peter, before it be ſupplied by art with a vegetable, for a mineral alcaline, baſe, or a ſalt for an earth.

§ 28. 1. The firſt cryſtals of the vitriolic ſalt of Epſom water, as well as of its ſubſtitute, the vitriolated ſalt of bittern, the common purging bitter ſalt of the ſhops; are very ſmall, and apt to deliqueſce, from the portion of the ſalt ley adherent to them. But, thoſe of each are rendered larger and more conſiſtent, by repeted cryſtalliſation, which diveſts it of bittern, or by the addition of allum, or of the vitriolic acid, which takes the place of the muriatic and gives a larger and firmer cryſtal; but of the ſame form and quality.

§ 29. 2. The figures of the pure cryſtals, both of the native and artificial vitriolate ſalts, are parallelograms; and their ſize, as well as that of all cryſtalliſed ſalt, depends upon the quantity of the ſolution, ſet to cryſtalliſe.

§ 30. 3. In taſte, it is cold and bitter. And upon every trial, perfectly neuter. But,

§ 31. 4. By volatile and fixed alcalies, added to the ſolution, the baſis is precipitated, in ſome meaſure, and a neuter ſalt of an other kind reſults from the combination, ſuch as Glauber's ſecret ammoniacal ſalt, with the volatile, and vitriolated tartar, with the fixed, alcali.

§ 32. 5. It diſſolves in a little more than equal weight of pure water.

§ 33. 6. Thrown upon the fire or an ignited iron, it neither crepitates, like ſea ſalt, nor fulgurates, like ſalt peter; but fuſes and then is converted to a ſolid dry maſs.

§ 34. 7. Expoſed to a warm, dry air, it loſes its pellucidity, and abates of its weight, by the loſs of its humidity. This reſtored, it is again increaſed in weight, and reduced to the priſmatic, cryſtaline form.

§ 35. 8. In a crucible, theſe cryſtals readily fuſe and run liquid. If the fire be urged forcibly, the native ſalt loſes ſome portion of its acid. If it be done in a retort with a recipient, ſome of this acid may be condenſed and collected, which proves to be of the volatile vitriolic kind. In this the artificial vitriolic ſalt differs; that it loſes nothing perceptible of its acid in the fire; becauſe it is of the more heavy or fixed kind.

§ 36. 9. If any coaly matter be thrown into the crucible, in which this ſalt is fuſing; it does not flagrate or fulgurate, as nitre does; but mixes and flows ſmoothly and uniformly, and gives a maſs, that, by fuſion, is capable of diſſolving all metals and metallics; that flows in the air; tinges the ſkin yellow; diſſolves partly in rectified ſpirit of wine, and gives it a golden tincture; diſſolves readily in water, giving it a greeniſh yellow tincture; and by the addition of any acid, precipitating a fair white magiſtery of ſulphur, generated by the union of the vitriolic acid in the ſalt, with the phlogiſton of the coaly matter. This magiſtery fuſed gives common brimſtone. Whence, the maſs, from which it was obtained, appears to be an Hepar ſulphuris.

§ 37. 10. Theſe like effects are produced with the ſalts of the waters of Sedlitz, of Epſom, of Cheltenham, of Scarborough; with the priſmatic ſalts of the waters of Bath and Briſtol, as well as with the common purging bitter ſalt, commonly, though falſly, called Epſom ſalt, and with that of Glauber. Whence, it may

may be reaſonably concluded, that when theſe appear to differ, they differ accidentally, not eſſentially. It is plane, that neither the natural, nor the artificial ſalts of this claſs bear any anology to nitre, and therefore, the giving that appellation to any of them is moſt abſurd and ridiculous.

§ 38. All the ſalts of this claſs are reſolvent, attenuent, cooling, aperient and diuretic; and taken in an advanced doſe, ſuch as from two or three to eight or ten drachms, they prove mildly purgative. So that they may be managed either as alteratives or evacuants, with great aſſurance of ſucceſs, where ſaline medicines of this tribe are proper. In viſcid foulneſſes of the inteſtinal channel, they are very ſerviceable, and are capable of removing variety of chronic obſtructions.

§ 39. Diveſted of their humidity by a ſlow heat, their doſes are beſt aſcertained in the form of a powder, which may be taken in any convenient vehicle. Great ſtreſs is layed by ſome upon the difference betwixt ſeveral of theſe ſalts. The Germans prefered our common bitter purging ſalt, to any among them known; till ſome of their chemiſts lately taught them the manner of making it at their ſalt ſprings. I think it equal to any, though we are ſo apt to run after their Sedlitz or Bohemian ſalt.

§ 40. Simple water is aſſuredly the beſt vehicle for any of theſe ſalts. But, it may be ſomewhat varied for patients, whoſe delicate palates and ſtomachs require another.

§ 41. I prefer Epſom water, in moſt caſes, to any artificial ſolution of the ſalts. It is a very mild, gentle alterative to a pint a day, at three equal portions, on the medicinal hours; or a mild and efficacious purge for the firſt paſſages, from a pint to three, drank within the compaſs of two or three hours.

§ 42. Our

§ 42. Our paiſants make very free with all our natural purging ſprings, quaffing them off without rule or meaſure, on moſt Sundays and Holydays. It would ſeem to be a ſort of a natural impulſe to free their bowels from the crudities of the quantities of almoſt raw fleſh and new cheeſe, they conſume: For, I have not been able to learn any ill effects from this gothic practice.

II. *Of*

II. *Of neutral, purging, chalybeate* WATERS.

Of CHELTENHAM WATER.

From a juſt ſenſe of due Reſpect,
As well as Gratitude,
To a moſt learned and judicious Phyſician,
And to a moſt beneficent, candid Friend,
This little Tract is inſcribed
To
ROBERT WATSON, M. D.
Fellow of the Royal College of Phyſicians of London,
And of the Royal Society.

§ 1. CHELTENHAM is a village, conſiſting principally of one ſtreet, of about a mile long, with a very few returns and lanes or adjoining houſes, and one ancient pariſh church. Before the reformation, it was ſubject to a convent of religious women. The eſtate being veſted in JAMES LENOX DUTTON, Eſq; he holds with it the temporality of the convent, and governs the diſtrict by a ſeneſcal, whoſe juriſdiction does not, that I can find, extend to great or capital matters.

§ 2. This village ſtands in a ſandy vale, on the northward ſide of an high ridge of hills, compoſed of ſoft white, granulated rocks, that partly diſſolve in acids; lying, on the town ſide, quite bare; within

in fourteen miles ſouthward of Tewkſbury; twenty miles north weſt of Cirenceſter, and eight miles north eaſt of Gloceſter, in the ſame county [a].

§ 3. The ſoil, to the north and eaſtward of the town is ſandy; to the ſouth and weſtward, loamy and wet; ſhewing in many places oozings from mines of iron.

§ 4. The waters all about the town are, for the moſt part, ſo hard as to ſerve no purpoſes of life, till they are ſoftened. To render them fit for waſhing, the ruſtics infuſe bags of wood aſhes in them; which they have in plenty, this being the common fewel of the country, and which they carefully collect and keep for this purpoſe principally. They find this, by experience, anſwer their purpoſes, without being able to account for it. They are pleaſed with finding their water, by this means, become milky, and think it is rendered ſopy. But, the cauſe is this; the water is hard, becauſe, by the means of an acid, it is highly charged with a calcarious earth. This acid, more ſtrongly attracting the alcaline ſalt in the aſhes, than the abſorbent earth, quits this, to unite with that; whence, the earth muſt be precipitated; while new combinations are formed; the one of an alcaline ſalt and the vitriolic acid, vitriolated tarter; the other, a ſurcharging of the water with the alcali, which makes it lixivial or ſopy.

§ 5. Some hundred paces to the ſouthward of the church, about the foot of a ſloping meadow, of loamy ſoil, in a north aſpect, riſes a little ſlow, obſcure, ſpring, ſayed to be firſt diſcovered by pigeons reſorting to it for its ſaltneſs; eſpecially in hard froſty weather, when all the other waters about were froſen; which this has never been obſerved.

[a] A ſituation, that ſeemed to have pleaſed the Romans: For, upon the high rocky hill, ſouth-eaſt of the town, the ruins or foundation of a Roman camp is ſeen. As well as a Roman cauſway and ſome other monuments of thoſe generous conquerors, betwixt Cirenceſter and Gloceſter.

§ 6. I made mine experiments and obſervations at Cheltenham, in the months of September, October and November. In the firſt and ſecond, the weather, for the moſt part, was warm, dry and ſerene. In the third, ſomewhat tempeſtuous, with rain, ſnow and froſt.

§ 7. The well is now ſunk ſome five or ſix feet deep, covered over with a little dome and cloſe ſhut down, by doors that exclude the freedom of the air. Whence, it is ſometimes, in very hot moiſt weather, found to ſtink, like any ſaline putrid water; which the practiçioners or drinkers have not yet objected to; all judging it to ariſe, according to the vulgar notion, from ſulphur. But, there are few, if any, waters, that may not, by the like means, and in this ſenſe, be rendered ſulphurious; which, according to mine humble opinion, are onely putrid [a].

§ 8. I did not find the water in this ſtate, in which many have obſerved it. I found it pretty clear, colerleſs; but not the moſt perfectly bright. It had hardly any remarkable ſmell; and taſted ſaline, bitteriſh and ſlightly vitriolic. It may be rather ranked among the diſagreeable, than the agreeable to the palate.

§ 9. I then put it to the following trials;

§ 10. 1. Set in a glaſs in the open air, it throws ſome air bubbles to the ſides of the glaſs, loſes of its pellucidity, grows more effete or leſs ſmart to taſte, and loſes its quality of tinging with galls. And upon ſtanding longer, lets an inconſiderable quantity of an ochrous earth ſubſide.

§ 11. 2. In this condition is all the ſurface of the well, which is ſo ſlow, as not to overflow, in the drier ſeaſons; it is there bereft of all its volatile parts, covered with a variegated pellicule, and void of iron, in a ſtate of ſolution, capable of tinging with galls, for five or ſix inches below the ſurface. Wherefore, the

[a] Part I. § 289. Part II. Introd. § 46. to § 49. Salt ſprings § 25, 26, &c.

water

water is beſt taken from the bottom of the well, as near the ſource and as unchanged as may be; as it now is by the means of a pump.

§ 12. 3. The mentioned phial full, of the unaltered water, weighed four ounces, ſix drachms and one ſcruple.

§ 13. 4. The water taken from the ſurface of the well, or deeper, after being by any means expoſed to the air, or even ſecured in a bottle by the cloſeſt ordinary corking, for a few hours, gives none indication of being chalybeate. But, recently drawn, upon the addition of a few drops of infuſion of galls, to about twelve to two ounces, it ſtrikes a pale, but vivid purple inſtantly. Viewed in ſome hours after mixture, the coloring matter appears depoſited in a ſediment of a deeper purple dye; while the ſupernatant liquor appears of a ſad green at the top, under a deeply variegated pellicule, and about the middle colorleſs.

§ 14. 5. The tincture of logwood, in the like proportion, gave a deep mazarine blew, nearly inky. In twelve hours, the coloring matter was changed to a dark brown and precipitated; leaving the ſupernatant liquor of a pale beer color.

§ 15. 6. With ſirup of violets, in the ſame proportion, the ſame effect, rather deeper, than in Epſom water is produced; becauſe of the martial earth.

§ 16. 7. With volatile and fixed alcalies, in a liquid form, the ſame effect, as at Epſom; rather a greater ſediment, and not ſo white, becauſe of the martial earth.

§ 17. 8. With all the mineral acids, and even deſtilled vinegar; a ſeeming contraſt and ebullition was produced; the water became more bright; kept its pellucidity; ſhewed more air bubbles than ordinary on the ſides of the glaſs; and that, charged with the vitriolic acid, preſerved its purple tinging quality with galls. All, as I apprehend, ariſing from the martial

earth diſſolved by nature in a more ſubtil, volatile acid.

§ 18. 9. The metallic ſolutions, EPSOM 9, 10, 11, 12 had all the like effects on Cheltenham, as on Epſom water; except that the ſolutions of ſilver and lead were more colored in the former, than the later; that the ſolution of quickſilver in the acid of ſalt, ſuffered no ſenſible change; but ſhewing a diverſicolored pellicule, and that in the acid of nitre, was not ſo deep a yellow, being more mixed with earthy parts.

§ 19. 10. It decompoſes ſope, much as Epſom water does. But,

§ 20. 11. It does not ſo effectually, in the ſame proportion, curdle milk, nor very perfectly in any.

§ 21. 12. Diveſted of its ochrous or martial earth by ſtanding, this water anſwers all the teſts of that of Epſom, with all the mixtures, except the ſolution of corroſive ſublimate; ſhewing onely a ſtronger impregnation with earthy matter by the heavier precipitates, with alcalies eſpecially.

§ 22. 13. Each pint of this water yields, upon evaporation, firſt the ochrous earth, which before it gets a boiling heat, ſeparates and ſubſides. This, ſeparated by filtration and dried, weighs about half a grain. Soon after, a terrene pellicule appears on the ſurface and ſubſides in granules, like ſand, to the bottom. Over this, the humidity being exhaled, the ſalt appears of a ſnowy white. It does not abſorb quite ſo much humidity from the air, as the reſiduum of Epſom water; having leſs bittern in it; whence alſo its ſalt ſtands drier and firmer, than that of Epſom. All together weighed ſixty eight grains.

§ 23. 14. This, being diſſolved in deſtilled water and filtrated, left better than one third earth behind it; the reſt a pure ſalt, which in cryſtaliſing left but little bittern.

§ 24. The difference then between Epſom and Cheltenham water is, that the one is never known fetid or putrid, being but an impregnation of water with the pure native vitriolate ſalt, with a little bittern,

ſome

ſome earth and a very ſmall portion of an alcaline matter, which appears by no teſt but that of corroſive ſublimate; the other is ſometimes found fetid, as I am informed; contains a volatile vitriolic acid, charged with iron; of the later of which about half a grain is found by filtration of a pint of the water, when the ſpirit has by any means eſcaped. To this add, a greater quantity of earth, partly ſelenite, but moſtly calcarious; which probably helps to hinder its coagulating milk ſo effectually; the ſame kind of ſalt more conſiſtent, with much leſs bittern, as well as of the oily matter.

§ 25. The ſalts of each, when equally pure, afford cryſtals of the ſame figure and qualities.

§ 26. Scarborough medicated waters appear, by the teſtimonies of thoſe, that made the experiments at the ſprings, and thoſe, I have made in London, to be impregnated upon the ſame principles with the Cheltenham. 1. Each loſes its purple tinging quality with galls, which appears to be from the loſs of the volatile vitriolic acid: For, as upon this loſs it grows turbid and lets an ochrous earth ſubſide; ſo, upon the addition of a ſufficient quantity of the common artificial vitriolic acid, it regains its tinging quality with galls, as at the firſt, to the confuſion of the volatile vitriol-catchers. When this ochre is ſeparated by filtration it anſwers all the trials of filtrated Cheltenham water; but, the pint yields not above fourty grains of ſolid contents upon evaporation; of which, about a ſixth part conſiſts of ochrous and calcarious earths; the former, ſeparated by filtration and dried, makes about the fourth of a grain; the reſt a ſalt of a more hard and conſiſtent nature than either of the preceding, with a more auſtere taſte and ſome tendency to the form of alum in its cryſtals; of which, it is probable, it will be found to partake. Hence, it probably has the faculty of curdling milk more effectually than any neutral chalybeate water to me known.

§ 27. When the humidity is near exhaled it appears colored, even after all the ochrous parts are ſeparated by

by filtration. This is from the oily matter, which is onely to be ſeparated by rectified ſpirit of wine or by fire. In cryſtalliſation, it remanes in the bittern.

§ 28. To this claſs, a great number of our purging ſprings may be reduced; particularly thoſe of Stratford; as appears by an ingenious eſſay written upon this ſubject by the learned and judicious Doctor BAYLIES. Though this tract muſt however be looked upon as one of the Doctor's juvenile performances; being publiſhed when he was onely a ſtudent of phyſic, before he was graduated; yet, it contains much uſeful knowledge and phyſical and chemical learning; the later particularly agreeable to the then received notions of ſulphur and volatile vitriol; which he now with riper judgment explodes. From this gentleman, we learn, that the waters of Stratford contain a volatile vitriolic acid; ſome portion of phlogiſton; ſome iron; ſome abſorbent earth; a native vitriolate and ſome muriatic ſalt, with ſome bittern; in all which, it correſponds with the preceding.

§ 29. As in the nature and quality of the principal ingredient, the native vitriolate ſalt, all waters of this claſs agree; ſo are their virtues and operations founded on the ſame principles. In obſtinate obſtructions and ſcurvies, in cold, phlegmatic conſtitutions, thoſe impregnated with iron muſt be, as experience ſhews them, the moſt effectual. Of theſe, it is very remarkable, that purging with them is rarely, if ever, attended with any degree of dejection. For, while the ſalts diſſolved in the waters purge, the mineral ſpirit, charged with iron, warms and invigorates the whole frame.

§ 30. In theſe, the paiſants commit extraordinary exceſs, without feeling any ſenſible ill effect. I have ſeen old men drink Cheltenham water by the quart, without number or rule. Upon enquiring their intention and method; they have anſwered, they had drank them on Sundays and Holydays for upwards of thirty years. They ſayed, they had no diſorders; but,

but, they reckoned it wholeſom to clean their bodies; and they had no rule, but to drink till the water paſſed clean through them. Yet, I have not been able to diſcover any ill effects from this ſtrange practice.

§ 31. The beſt ſeaſons, for going through a continued courſe of any of theſe like waters, muſt be in the ſummer months; though for a doſe or two, they may be taken at any time. They may be managed as alteratives or purgatives to excellent purpoſes in a variety of obſtinate caſes. Their doſes are much alike; though, the proportions of their ingredients ſomewhat differ.

SECTION IV.

Of the medicated WATERS *of the principalities of Liege, Malmendy and Stavelot, of the* SUBACID, CHALYBEATE *kind.*

With due Reſpect and Humility,
Inſcribed
To the Right Honorable
The LORD KINGSTON.

§ 1. THESE countries and the mineral waters they produce, bear ſo great analogy the one to the other, that they naturally fall under our conſideration in one point of view: The waters being the Acidulae of the antients; the Chalybeatae of ſome; the Acidulae chalybeatae, the ſubacid ferrugineous waters, of others; to whoſe ſentiments and appellation, I ſubſcribe. Under this head, the waters of Pyrmont may be compriſed.

§ 2. Luyck or Liege, the capital of the principality, to which it gives name, is a conſiderable city in the county of Haſbaye in Flanders. It is deemed an Hans or imperial city, ſubject to its biſhop; who in virtue of his election by the members of the great collegiate church, which are a kind of feudal lords, called Trefonciers, whoſe places are alſo elective by this choir; becomes at once their biſhop and a temporal ſovereign prince of the German empire.

§ 3. In this city, there is an univerſity and a college of phyſicians, neither at preſent of eminence enough to demand any attention.

§ 4.

§ 4. This town ſtands upon the ſide of an hill, in a fertile, though hilly, country, upon the banks of the famous river Moſa, the Maeſe or Meuſe; about fourteen miles, to the ſouthward, from Maeſtrecht; twenty northweſt from Limburg; fivety four eaſtward from Bruxelles, and ſixty from Cologne; in latitude fivety degrees forty two minutes, longitude twenty five.

§ 5. The territories of this prince are extended on either ſide the river. Both are rich in mines of different kinds; but chiefly in foſſil coal, pyrite and iron.

§ 6. The tranſmoſan territories of Liege extend to the eaſt ſide of the river. I ſhall hear confine myſelf ſolely to a view of thoſe parts, that relate to the mineral waters at preſent under conſideration. Theſe are the marquiſate of Franchimont, which gives the prince of Liege one of his titules. This is divided into five bans or diſtricts, 1. that of Theux, a village famous for iron works of every kind; its diſtrict being rich in iron mine. Here is alſo a fine quarry of beautiful black marble. In this, the famous antique caſtle of the marquiſſes of Franchimont ſtands; but, it is now uſed onely for a goal for the marquiſate; 2. that of Vervier, a very large, handſome, populous and opulent village, celebrated for its manufactures of woollen cloaths; 3. that of Jalhay, remarkable for nothing more, than being inhabited by induſtrious laborious paiſants, chiefly plowmen; 4. that of Sart, inhabited by the like ruſtics; in this diſtrict the medicated fountane, called Niveſet or Nivezeè, and Sart, ſprings; and 5. that of Spa, of late, by the fame of its waters, become a very conſiderable large village.

§ 7. All this country is compoſed of rude, and moſtly, uncultivated mountanes, partly dry and rocky, partly wet and boggy; ſome bare and barren, others covered with wood, coppice, furz, heath, broom, gaule, club-moſs, &c. The valleys in general are more

more fertile, eſpecially where a little art and labor has been expended in the culture.

§ 8. To an eye ſated with the wide extended lawns, the fertile fields of Flanders, the country of Franchimont muſt afford a moſt delightful variety. Here, nature ſeems to have ſported in the creation with a wanton hand: The moſt poetic genious can hardly conceive, and much more hardly deſcribe, the endleſs diverſity of beautiful, wild landſcapes, with which the ſenſe is feaſted in every part of this country: For, turned which way it will, a moſt pleaſing variety of hill and dale, further diverſified with wood, preſents itſelf to the view, all liberally watered with ſprings and rivulets; ſome ſweet and ſimple, ſtored abundantly with fiſh of ſeveral kinds; others charged with ſuch mineral matters as render them unfit for the natural inhabitants of that element; ſome ſlow running, but moſt quick, rapid, and even precipitate in their courſe; ſo as to riſe from dimpled brooks or murmuring rills, to roaring caſcades or cataracts.

§ 9. Every part of this country abounds with iron mines of one kind or other. Hence, we ſee numbers of forges for ſmelting the ore, as well as for working the metal into various utenſils. Many of theſe are now in ruins; particularly about Spa, not from any want of ore, but from the fewels becoming ſcarce by the exceſſive conſumption.

§ 10. The mountanes are, together with various earths, ſands, &c. compoſed partly of rocks, of grit or limeſtone vened with ſpar and ſometimes with cryſtal, or of immenſe quantities of a ſoft fiſſil ſtone, a kind of ſlate, of a light blew and ſome of an aſh color or pale brown; whoſe fiſſures are colored with a martial earth, in appearance, like actual ruſt of iron.

§ 11. The principal iron ores found about this country are,

1. Minera ferri cryſtalliſata [a]; iron mine of a cryſtalline form, and of a light liver-color, partly tending

[a] WALLER. Mineralog. p. 460.

to

to octogons and partly to cubes. This is hardly, if at all, attracted by the magnet. Though it be rich in metal.

2. Minera ferri nigricans, magneti amica[a]; the dark-colored iron ore, anſwering to the load-ſtone. Of this, there are ſeveral varieties; ſome being paler or deeper colored; ſome more or leſs ſolid; ſome ſeemingly ſtriated or lamellated; others ſcaley, teſſulated, or breaking into cubes, granulated, &c. All rich in metal and attracted by the magnet.

3. Arena ferraria[b]; iron ſand. Of this I have ſeen great variety, from a pale yellow, to a ruſt color and a very dark brown.

4. Ochra. Ferri terra precipitata[c]; Ochre, or martial earth precipitated. Iron decompoſed; that is, ſpoiled of its phlogiſtic and metalliſing principles. Of this great variety is found, differing onely in ſhades of color, from a pale yellow to a red and dark brown.

§ 12. Though theſe abound univerſally in this part of Germany, I can not attribute the impregnation of any of the medicated waters, of which I am about to treat, to any of theſe, nor to any variety of them. Theſe moſt certainly derive their origine from vitriolic earths or decompoſing pyrites, with which the country plentifully abounds. Theſe are ranked, ſometimes with ſulphur, ſometimes with iron; as the one or the other predominates. There are pyrites compounded with other metals and metallics; but thoſe, that are obſervable in this country are,

1. Sulphur ferro mineraliſatum, minera difformi, pallide flava, nitente. Pyrites ſulphureus rudis. Pyromachus veterum[d]. Sulphur mineraliſed with iron, in a difformed ore, of a ſhining, pale, yellow color. The rude ſulphureous pyrite or fire-ſtone. The pyromachus of the antients.

[a] WALLER. p. 463, 464. [b] Ejuſd. p. 473, 474. [c] Ejuſd. p. 478, 479. [d] Ejuſd. p. 379.

2. Sul-

2. Sulphur mineraliſatum, minera globoſa concretum. Globuli pyritacei[a]. Mineraliſed ſulphur in a globular concrete. Fire-ſtone balls.

3. Sulphur ferro mineraliſatum, forma cryſtalliſata. Marchaſita. Cryſtalli pyritacei. Druſa pyritacea[b]. Sulphur mineraliſed with iron in a cryſtalliſed form. Cryſtalliſed fire-ſtone. Known to our miners by the name of Mundic.

§ 13. Theſe, with ſeveral varieties of them, in color, conſiſtency and form, are the principal pyrites, that have fallen under mine obſervation in this country. The firſt and ſecond are the moſt common. Theſe are ſo plenty, that formerly ſeveral works were carried on in various parts of this country for extracting ſulphur and vitriol of iron from them. The ruins of one of theſe works is ſtill ſeen juſt by Franchimont. While another is carried on vigorouſly at Praion, near Chaud-fontaine.

§ 14. As the ordinary mines of iron ſtand unaltered in the open air, and are, for the moſt part, not onely incapable of impregnating water, but inſoluble, even in the mineral acids; we are not to look for chalybeate or ferrugineous waters from mountanes of ſuch ores.

§ 15. But, as moſt pyrites are decompoſed in the open air; that is, abſorb humidity, grow hot and even catch fire and burn, ſo as to conſume the phlogiſtic or inflammable parts, then leaving the other component part of the ſulphur, the univerſal acid, to prey upon the iron ore in the concrete; it is eaſy to conceive how waters may be heated and diverſly impregnated, hot or cold, with one, two, or more of the conſtituent parts of the pyrite: From theſe, 1. the phlogiſton ſeparates and the mercurial principle; which may be imbibed by any adjacent bodies, and held longer or ſhorter, according to their reſpective affinities. 2. A portion of the univerſal acid ſubtiliſed and vo-

[a] WALLER. p. 381. [b] Ejuſd. p. 384.

latiliſed

latiliſed by ſome phlogiſton, eſcapes, flies off, and mixes with contiguous water, or the incumbent atmoſphere. Hence, the water as well as air in the neighbourhood of theſe like mines, muſt be replete with acidity. 3. After theſe volatile or volatiliſed parts eſcape, the concrete ſulphur is deſtroyed, and a new compoſition is produced; the union of the fixed mineral acid, the baſis of the concrete, ſulphur, with the martial earth; whence, a vitriolic magma is prepared, which is partly ſoluble in water, which it impregnates with ferrugineous or vitriolic particles; that is, with iron diſſolved in the univerſal acid. From this quarter, do all the medicated waters, of the chalybeate kind, in this part of the world, and perhaps in every other, deduce their origine. How baths are produced by the ſame cauſe, ſhall be explaned in its place.

§ 16. The ſeveral bans or diſtricts before mentioned are ſo many incorporate communities, that have their own magiſtrates, are intituled to be governed by antient municipal laws, within themſelves; under the ſovereignty notwithſtanding of the biſhop of Liege; from whoſe courts, however, they happily have an appeal to a ſuperior juriſdiction, under the emperor of Germany, in what is called the Imperial Chamber. Now to particulars.

§ 17. SPA is a village in the marquiſate of Franchimont, which was of none account before the diſcovery of the mineral waters, about the year 1326. which has ſince rendered it conſiderable by the numbers of ſtrangers, that have of late reſorted it, for the uſe of its ſalutary ſprings. Since the concourſe of the drinkers has increaſed, the village has in ſome ſenſe changed it's ſituation, that is, the old village is much neglected for a new one, more contiguous to the principal ſpring.

§ 18. Between Franchimont and Spa, a ridge of high hills, of ſome miles in length, runs from eaſt to weſt, moſtly covered with heath, broom and wood.

On

On the ſouth ſide of one of the higheſt of theſe hills, where a prominence of about three or four hundred yards, from the ſide of it, forms near a right angle with the body of the mountane, and very cloſe to both, ſtands the new village of Spa, in a ſouth weſt expoſure, well ſheltered from the north and eaſt.

§ 19. The town conſiſts of a large pariſh church, a convent of bare-footed, mendicant monks, called, from their dreſs, Capucins; one large ſtreet, or rather two joined by a bridge upon a mountane ſtream, that runs through it, with ſeveral ſmaller ſtreets and rowes of houſes; the older irregularly built, moſtly of wood and plaſter; the more modern, more methodically, of brick or ſtone. It is large enough to accommodate ſeveral hundred perſons in a ſeaſon.

§ 20. The ſoil about the town is rocky, gravelly or loamy, with ſome mixture of iron ore of one kind or other, more or leſs viſible almoſt every where. On the rocky, gravelly or ſandy hills, it is dry; but, on the loamy and boggy, it is exceding wet. Even the drieſt hills abound with ſprings; ſo that the air in general muſt be moiſt. Add to this, that great abundance of rains fall there, even all the ſummer long, as well as great ſnows in winter. The beſt weather there is generally in the months of September and October. There are moſt heavy dews and thick miſts all over this country, in the moſt dry, warm weather. Whoever gets to the tops of the hills, in a morning, before the ſun diſperſes theſe vapors, may ſee them in the vales ſo thick and ſometimes with ſuch an undulating motion from the air, as very well reſemble huge lakes of water. Thus, have I often ſeen them, in taking mine early ſurveys of the country and it's ſprings.

§ 21. Though this part of the country be extremely well furniſhed with water, where ſeveral rivulets uniting make a conſiderable large one in the town; there is no great plenty of pure ſweet water. The larger ſtreams run from the mountanes; where they are charged

charged with the waſhings of turf, a kind of bitumen; and the ſprings are in general charged with ſomething mineral.

§ 22. However, there are ſprings of ſweet water fit for all the common purpoſes of life; ſome of which are conducted by aqueducts to the town; one of which plays inceſſantly in a pretty fountane in the middle of the great ſtreet. There is likewiſe a conſiderable ſpring in Rue du Faaz, as it is called, where the water runs into a wooden trough. But, it is remarkable, that neither theſe ſprings, nor even rain water at Spa, are as free from acidity, as ſuch may in moſt other places be found.

§ 23. In order to compare theſe and other waters, and to prepare infuſions and ſolutions, with deſtilled water; I took rain water and deſtilled it carefully in a clean glaſs cucurbit, with a fit head and recipient.

1. A certain phial with it's ſtopple, which contained about two ounces and an half, filled with this water, quite cold, weighed ſix ounces, two drachms, two ſcruples and three grains.

2. The ſame, filled with rain water, weighed one grain more.

3. The ſame, filled with ſpring water from the fountane in the great ſtreet, weighed near a grain more than the ſecond. And,

4. The ſame, filled with water from the ſpring in Rue du Faaz, weighed above half a grain more than the third.

§ 24. The 1. ſuffers no commotion or change with fixed or volatile alcalies, in a liquid form, being dropped into it. Changes not the color of ſirup of violets. And bears the mixture of acids, without any perceptible commotion, and that of metallic ſolutions, without any ſenſible precipitation.

§ 25. The 2. upon dropping liquid alcalies into it, after agitation, ſhews a ſlight commotion with ſome few air bubbles. Strikes firſt a pale red, then a pale roſe purple, and laſtly a ſky blew, with the ſirup of violets.

Cauſed

Cauſes a milkineſs in the metallic ſolutions; thoſe of ſilver and lead particularly.

§ 26. The 3. is not altered for ſome time by the addition of twenty drops of ſpirit of ſalt ammoniac, or ley of tartar, to two ounces; but, upon mixture, or letting them ſtand about a minute together, a ſenſible ebullition is ſeen. It likewiſe changes ſirup of violets, firſt red, then to a pale roſe purple, and laſtly, leaves it of a ſky blew. And precipitates ſolutions of ſilver and lead, white.

§ 27. The 4. produces all theſe effects; the ebullition with the liquid alcalies in particular, more ſenſibly than 2. or 3.

§ 28. Theſe experiments ſhew the pureſt water at Spa contains ſome acidity more than ordinary; and as the rain water is not found free from this acid, it is to be preſumed, that the air of that country is changed with this ſubtil, volatile acid, which gives the principal virtues, as well as the denomination of Acidulae, to the medicated waters of theſe parts, as ſhall be explaned in the ſequel.

§ 29. This village ſtands, in longitude twenty five degrees, twenty five minutes; in latitude fivety degrees, twenty five minutes, about twenty miles ſouth weſt of Aken; nine miles ſouth of Limburg, and about twenty one ſouth eaſt of Liege. It is very hot in the ſummer, as it is cold in the winter, when the weather is regular. It is however found in moſt uncertain. When it is hot, it is generally attended with very violent lightening and thunder; which may be eaſily conceived and accounted for from the abundant mineral exhalations from a country ſo replete with pyrite.

§ 30. However wild and barren the ſituation of Spa may appear, it is neverthelefs plentifully furniſhed with all the commodities of life, as ſoon as the weather is found to invite ſtrangers thither; which is ſeldom before the middle or later end of May. It is famous for milk, exceeding moſt others in richneſs;

whence

whence they muſt have good butter. The mutton of the Ardennes, which is the country round it, is the beſt I have ſeen any where. And the beef is inferior to none, upon the continent. Beſides, plenty of very good tame foul is always to be had there, and variety of wild foul in the ſeaſon; ſuch as grouſe, pheaſant, two kinds of partridge, the common and one, called gelinote, quails, &c. after the later end of Auguſt; as alſo hares, roebucks and wild boars. Here likewiſe, plenty of freſh water fiſh, as crawfiſh, trouts, eels, roches, carp, tench, &c. are found. Nor are fruits and garden ſtuff in general wanting in Spa, though the beſt are brought from Liege. And there are wines of all ſorts had there, at a moderate price, notwithſtanding long carriage and an impoſt layed on them for the prince. Beſides, during the water drinking ſeaſon, the town is, like a fair, furniſhed with variety of toys, &c. Then, ſtrangers may be furniſhed with lodgings, from a ſingle room, to an entire houſe, large enough for any private family, with ſtabling and every ſuch like accommodation, all tolerably convenient and at a moderate price. So that none of the neceſſaries of life are wanting here, for thoſe, for whom a courſe of theſe waters, in this climate, may be proper.

§ 31. Then, as Exerciſe and Amuſements are eſſentially neceſſary to ſuch courſes; here are beautiful and healthful rides, on every ſide of the village. Beſides great variety of the moſt pleaſant, romantic walks, many of them layed out and moſt of them much improved of late, chiefly by the voluntary contributions and remarkable munificence of the ladies and gentlemen of our country, under the direction of a moſt public ſpirited and benevolent gentleman, Mr. BERKELY. But, here nature, beyond any thing, that art could ſupply, has bountifully provided againſt the heat, which might otherwiſe in ſome ſeaſons, be intollerable on the ſouth ſide of the mountane: For, by it's highth, and the prominences from it's ſide,

ſome of the pleaſant meadows in the vale, all watered with meandring, purling brooks and rivulets, are effectually defended from the ſun, in the hotteſt hours of the day; ſo that a ſhady walk, open to the ſky, is never wanting after four of the clock at Spa.

§ 32. And for evening diverſions, there are public rooms for aſſemblies every night, and balls two or three times a week. It is to be wiſhed, that theſe were onely uſed in a phyſical ſenſe here, and at all ſuch other places, as are reſorted to for the recovery of health. But, they are here, as elſewhere, carried to all the exceſſes of dreſſing and conſequent inaction, or of too long and too violent exerciſe in dancing; and cards are made a buſineſs, a trade inſtead of an amuſement, or means of diſſipation of thought and attention.

§ 33. Now to the medicated waters. Of theſe, there is great variety all over this country, not confined to the diſtrict of Spa onely. Theſe however, were the firſt taken notice of. And, as their fame extended, ſo the name given theſe, either of Spa or Pouhon, has been borrowed, and abſurdly, if not fraudulently, given to all waters, judged to bear any analogy to theſe, not onely in this neighbourhood, but further into Germany, and even here in Britain.

§ 34. The medicated waters within the diſtrict of Spa are thoſe of the ſprings, called 1. Pouhon, 2. Sauveniere, 3. Groiſbeeck, 4. Geronſter, 5. Pouhon Pia, and 6. Barriſar. Of which the 5. and 6. have hitherto eſcaped the notice of all the authors and practicioners of any repute.

§ 35. Theſe waters have, from their firſt diſcovery, been deemed the property of the community of Spa, who continued in peaceable poſſeſſion of them, and layed a ſmall impoſt upon ſuch as were exported under their ſeal, in order to keep up their reputation and to raiſe a ſmall fund for ſupporting their church, mending their high ways and other public uſes. Thus, they continued till the preſent prelate acceded

to

to that amphibious tyranny, a ſpiritual and temporal principality in one. This gentleman, coming from a country, where the ſubjects are no better than vaſſals, and having filled his new court with creatures and miniſters of this caſt, was readily induced to think the property of the Ligeois at his abſolute diſpoſal; and envying the poor people of Spa the pitiful cuſtom of a penny a flaſk on their waters, ſeiſed them into his own hands, and diſpenſed them as he thought fit, under the direction of a guard of miſerable ſoldiers. This monopoly might have ſucceded to the ſatisfaction of his cardinal highneſs, who had already corrupted the perfidious burgomaſter, Lambert Heyne, to comply with his deſigns; had not a remnant of the ſpirit of gothic freedom ſtill ſubſiſted in theſe poor mountaneers; who, though by ſuperior power and the decrees of a little ſervile court, forced for a while to ſubmit to this ſhameful and violent invaſion of their property, had at length recourſe to a ſuperior tribunal, the imperial chamber at Waſler, where they were reſtored to the full enjoyment of their antient rights and privileges in this reſpect, to the great diſappointment and ſhame of this petty prince and his pitiful mimic train of diminutive courtiers and dependents. This definitive ſentence was paſſed in the year 1745; ſince which, the waters have been reſtored to the antient rightful proprietors, and by them in the uſual manner diſpenſed.

§ 36. Before I procede to examine the ſeveral medicated waters, I chooſe for the ſubject of this part of mine eſſay, I judge it proper to give the name, ſituation, and ſome deſcription of each of the ſources, that have found worthy of attention. Theſe are within the diſtricts of Franchimont, Malmendy and Stavelot, or thereabouts. I can not pretend to diſtinguiſh meerings. I ſhall treat them in the order, in which they occurred; beginning at Spa.

§ 37. 1. The firſt diſcovered, and the principal from it's uſe and conſumption, is the ſourſe, called the

POUHON; which, in the jargon of the country, which ſeems compoſed of old French, Spaniſh and Low Dutch; implies a well, or a pit, from which water is drawn; and in the dialect of this people, is given to many other ſprings of this ſort. This is a large, ſlow ſpring, which riſes in one end of the great ſtreet, about the middle of the town. It ſprings from a ſoft, foſſil, or ſlatey rock, in which an irregular, deformed hollow is made, whoſe opening is about two feet broad and three feet and an half long, and it's depth, from the high water mark, in ſome parts, about three feet and an half, in others, about ſix. The water being drawn out of this well, as it is every night during the ſeaſon, it takes about three hours to fill it. And when it riſes to a certain highth, there is a ſmall opening by which the upper part is continually, though ſlowly, diſcharging; except when it is otherwiſe drawn off: For, I have ſeen it ſunk near two feet below the high water mark, by the water conſumed by the drinkers in one morning. As it ſprings, ſmall air bubbles are continually riſing and flying from it, in warm weather eſpecially; and by turns ſome large bubbles riſe with a variety of rumbling humming and whiſtling ſounds.

§ 38. As the ſpring ſtands on the ſouth ſide of the hill, it's overflowing water muſt run, as the ground leans, to the ſouth; but, upon viewing the well, when the water is drawn off, the ſprings appear to come from the fiſſures of the rock, in almoſt all directions, but chiefly from the north and eaſt. To the ſouthward, a mountane brook runs within a few paces of it. Yet, I could never learn, that the ſpring was ever affected by it, even when ſenſibly increaſed by the falls of rain; except upon ſuch great floods, as break into or overflow the ſource, which have ſometimes, but rarely happened. Of this, there is a very remarkable inſtance recorded in a kind of monkiſh chronography, upon the front of the nich that covers the ſpring. The words are

MarcCI poſtrIDIe aqVa appVLIt VsqVe.

This ridiculous method of recording events is common all over Flanders and Germany. Where any nonſenſe is inſcribed in this manner, to make the numeral letters, thus written in capitals, by being ſummed up together, point out the date or meaning intended; as here, M ſtanding for one thouſand, D for five hundred, C for one hundred, L for fivety, every V for five, and every I for one, give the year of the event 1674.

§ 39. The ſurface of the well is four or five feet lower than the pavement of the ſtreet in which it ſtands. It is ſurrounded with a paved area, of about twenty feet ſquare, with a parapet wall and ſteps to go down to the well. About this wall, the drinkers commonly ſtand to be helped with water, in glaſſes of the different ſizes required, by women, who attend the well for that purpoſe.

§ 40. The upper ſurface of the rock, to prevent it's mouldering and fouling the water upon every touch, is covered over with lead: I think injudiciouſly, when ſtone may be found to anſwer as well, without any evil effects to be apprehended from this metal.

§ 41. The whole is covered by an handſome ſquare ſtone building, arched and roofed, to keep it from the ſun or rain, and with an opening to the weſt. In a kind of pediment, over the door, are placed the arms of MAXIMILIAN HENRY of the houſe of Bavaria, ſome time prince and biſhop of Liege. The magiſtrates uſe the figure of the front of this building for a ſeal to the waters, they export, which have hitherto been always taken from this ſpring; with this inſcription, at top, SPA, underneath POUHON.

§ 42. Adjoining the area round the fountane, upon the ſouth ſide, ſtands a building conſiſting of one ſquare room with a large fire place, for the convenience of the drinkers in cold and wet ſeaſons. There is nothing remarkable in this, but a pompous latin inſcription, in gold letters, in the front, cut upon a black marble table, ornamented with enſigns armorial, &c.

whether as a mark of the gratitude or pride of the firſt civiliſed monarch of Muſcovy, I ſhall not ſay. At preſent, it chiefly ſerves to gratify the vanity of the people of Spa, who, like thoſe of all ſuch like places, pride in recording the arrival of perſonages of diſtinction to drink their waters; but, as it makes an anecdote in the life of this extraordinary man, as well as a part of the hiſtory of theſe waters, I ſhall tranſcribe it for the ſatisfaction of the curious;

PETRUS PRIMUS D. G. RUSSORUM IMPERATOR,
PIUS, FELIX, INVICTUS,
APUD SUOS, MILITARIS DISCIPLINAE RESTITUTOR,
SCIENTIARUM OMNIUM, ARTIUMQUE PROTOSATOR;
VALLIDISSIMA BELLICARUM NAVIUM
PROPRIO MARTE CONSTRUCTA CLASSE,
AUCTIS ULTRA FINEM EXERCITIBUS SUIS,
DITIONIBUS TAM AVITIS QUAM BELLO PARTIS
INTER IPSAS BELLONAE FLAMMAS IN TUTO POSITIS,
AD EXTEROS SE CONVERTIT;
VARIARUMQUE PER EUROPAM GENTIUM: LUSTRATIS
MORIBUS,
PER GALLIAM AD NAMURCUM ATQUE LEODIUM
HAS AD SPADANAS AQUAS,
TANQUAM AD SALUTIS PORTAM PERVENIT;
SOLUBERRIMISQUE, PRAESERTIM GERONSTERICI
FONTIS, FELICITER POTIS,
PRISTINO ROBORI, OPTATAEQUE INCOLUMITATI
RESTITUTUS FUIT,
ANNO MDCCVII. DIE XXII. JULIJ.
REVISISQUE DEIN BATAVIS,
AVITUMQUE AD IMPERIUM REVERSUS,
AETERNUM HOCCE GRATITUDINIS MONUMENTUM
HIC APONI PRAECEPIT,
ANNO MDCCXVIII.

Which, in our language, runs thus; Peter the firſt, by the grace of God, emperor of the Ruſſians, pious, happy, invincible, the Reſtorer of military diſcipline, and the firſt Founder of Sciences and Arts in his dominions; having, by his own ability, fitted out a moſt power-

powerful navy, augmented his land forces to a number almoſt infinite, and, amidſt the raging flames of war, given peace and ſecurity to his hereditary, as well as conquered, ſtates; viſited foregne countries; and having examined the cuſtoms and manners of various nations of Europe, paſſed through France, Namur and Liege, to come to the ſprings of Spa, as to the ſource of Health; where, having happily drank of theſe moſt ſalutary fountanes, particularly that of Geronſter, he was reſtored to priſtine vigor and wiſhed-for health, the twenty ſecond of July, in the year 1707. And having reviſited Holland, and returned to his hereditary empire, commanded this, as an eternal monument of his gratitude, to be here erected, in the year 1718.—I judged, this ſketch of the hiſtory of this extraordinary man, though not quite pertinent to our purpoſe, might be deemed worthy of a place here; as it ſhews us the fame of theſe waters to be ſuch, as could bring a monarch of the moſt extended and moſt remote empire in Europe, to ſeek the reſtoration of his health by their means; while it inlarges our ideas of human nature, when we ſee a man, born and bred a ſavage, and a deſpotic tyrant, look ſo far into the world, learn men, ſciences and arts, prize them properly and encourage them in his country, ſo as to bid fair for civiliſing one of the greateſt and moſt barbarous nations in the world. It ſeems, he had yet acquired but rude notions of infinity and eternity; when he applied the one to the multitude of his ſoldiers, the other to monumental marble and gold. But, this might have been the language of his flatterers, whom this monarch, though a ſavage, was yet too much a man to reſtrain or reform.

§ 43. 2. The ſecond is the fountane, called the SAUVENIERE. This vies inſeniority with the Pouhon. The generality giving it in favor of the former, and confounding this with a ſpring mentioned by Pliny in Tongre; but, the controverſy being of no ſort of conſequence to a phyſical enquiry, I leave it to be deter-

mined by ſuch as have more leiſure, and a ſtronger paſſion for reſearches, which are more amuſing than uſeful. The Sauveniere is as uncertain in it's etymology, as in it's hiſtory. Some derive it from Sabinus an imaginary roman general, others from Sabina, Savin, called in the jargon of the country Saviniere, from ſome imagined reſemblance to this plant, in certain effects. But, theſe are too trifling to be further inſiſted on. This fountane lies about a mile and an half to the ſouth eaſt of Spa. It ſprings ſlowly through a ſoft, fiſſil rock, like that of the Pouhon, upon the ſide of a very high mountane, covered on one ſide, with heath, broom, &c. on the other, with variety of wood, chiefly beech and oak. It ſprings ſlowly, with air bubbles, and variety of ſounds, as in the Pouhon, more or leſs in proportion to the heat or coldneſs of the weather. In the cold, they are ſmaller leſs noiſy, and leſs frequent; in the warm, larger more noiſy and more frequent. The difference, which theſe changes of weather cauſe is very ſenſible, viewed before and after ſun riſe in ſummer. A little irregular baſon has been made for it in the rock. This may be about twenty inches ſquare and twelve or fourteen deep. Being emptied, as it is every evening in the ſeaſon, it fills again in leſs than twenty minutes; the overflowings of it run, as the ground inclines, to the north eaſt, and depoſites a pale brown ochre in it's paſſages. It is covered over with a little hewn ſtone dome, with a door to the north eaſt. Over the door is ingraved, 1686. Round the well, a circular area, paved with broad ſtones, of about twelve or fourteen feet in diameter, is made with a rude parapet wall and benches. This is two ſteps lower, than the adjoining ground. The air about it is thin, clear and ſharp. Here is but a very deſpicable ſmall hovel to ſhelter the drinkers in wet weather. But, there are moſt pleaſant walks and ſeats, layed out by the before mentioned Mr. BERKELY, by the ſide of a rapid running brook, which makes ſeveral natural caſcades, by the well. Theſe command a very extenſive proſpect and are moſt agreeable, commodious and healthful.

§ 44.

§ 44. 3. A few ſteps higher than the area of the Sauveniere, and a few paces diſtant, to the ſouth weſt, another like ſlow-running, ſmall ſpring riſes from the ſame ſort of rock, covered with a little ſquare nich in the wall, that ſurrounds both wells. This is adorned with the arms of a gentleman, who found benefit by drinking this water, Baron GROISBEECK: He incloſed the true ſpring ſo as to keep it clear of any adventitious water, and ſet up his arms, with an inſcription, over it, as modeſtly as gratefully, ſetting forth his titules and the date of the feat, in 1651. This ſpring was, and by ſome ſtill is, called the Pequet; from attributing to this water the diuretic qualities of the juniper, known here by the name of Pequet; but, it is more generally known by the name of Groiſbeeck. It riſes ſlowly with air, bubbles and noiſe by intervals, like the reſt.

§ 45. 4. About two miles and an half weſtward of the Sauveniere, and two miles ſouthward of Spa, ſprings the famous fountane, called the GERONSTER. It lyes in the middle of a rude foreſt, upon a very conſiderable eminence above the town; but with an eaſy aſcent, and commands from it's walks a very wide extended proſpect towards the north and north weſt. The hiſtory and etymology of this ſource are alike uncertain. It is however certain, that this is not the fountane formerly known by this name: The remanes of that lies ſeveral paces to the ſouth eaſt of this; but, the vene was loſſed in digging about it, as ſome ſay, to inlarge it's baſon. The preſent ſpring lyes many feet lower than the old. And ſeveral ſtill lower, than the ground of every ſide of it, but the north. The ſoil about it is clayie and wet, though ſtoney. The ſtone is moſtly a common grit, vened with ſpar and ſometimes ſet with cryſtal. But, that, where the ſpring riſes, is of the ſlaty kind, like the reſt. The fountane ſtands in the middle of an area of about twenty paces from north to ſouth, and twelve from eaſt to weſt. This area is well paved with broad ſtones. The weſt

ſide

ſide of it is waſhed by a little rapid brook, that ſwells to an enormous ſize after violent rains. There are two eaſy entrances by ſteps into this area; one from the eaſt, the other from the ſouth. On the north ſide is a pretty large, ſquare building, conſiſting of a ſmall piazza or arcade in the front, with a large room and a fire place behind it. Over which is one large commodious room. Contiguous to theſe, ſeveral ſmall neceſſary offices are placed. The ſpring ſtands nearer the ſouth end of the area. From the level of this, one deſcends by three ſteps to the well, which is ſurrounded with a coved wall of about three feet high in a circular form. Over the well an handſome ſquare hewn ſtone canopy or dome is arched, and ſupported by four columns of red and white marble of the Ionic order of architecture. Under this, ſtands a ſmall round building, of the ſame ſtone with the columns, with an opening oppoſite to the ſteps, that come down to it; this covers the well like a kind of nich[a]. The fountane holds between three and four gallons, which quantity the ſpring throws up, with air bubbles and noiſe by intervals like the reſt, in about fiveteen minutes. To the weſtward of the fountane, a very noble, long, open gravelled walk is layed out by the care and judgment of the benevolent Mr. BERKELEY, with ſeveral ſmaller, ſhady walks in the foreſt. So that it is rendered, in all reſpects, commodious for the drinkers.

§ 46. 5. About a quarter of a mile to the north eaſt of Geronſter, lyes a large good ſpring, called POUHON PIA. It is a ſlow ſpring, in a ſoil like that of Geronſter, more cloſely environed with wood. It lyes quite open and neglected, a few looſe ſtones being onely ſet about it.

§ 47. 6. At leſs than a mile's diſtance, to the north weſt of the Geronſter, in a ſtoney valley, near a large

[a] Theſe were erected by the Count of BOURGSDORFF, in grateful acknowledgment of the benefit he received from the drinking this water in 1651. As appears by inſcriptions about the well.

rapid-

rapid-running brook, and not far from an hill of the ſame kind, of ſlatey rock, as abound about Spa, ſtand two ſprings very ſlow running from the like bottom with the reſt. Little or none art has been expended on theſe. They have onely been incloſed, not covered. The ground ſeems to have been a little cleared and levelled about them; but, they are now left quite open and neglected. The place is called BARISART, of which I could never learn the hiſtory or etymology.

§ 48. To theſe, three other fountanes, in the neighbourhood, though not all in the diſtrict, of Spa, or within the juriſdiction of the community, may be added; I mean,

§ 49. 7. That, called the WATROZ is not quite half a league to the eaſt of Spa, in a valley, about a quarter of a mile to the northward of the Sauveniere. It lyes between two rivulets, one but ſmall, cloſe by it, to the eaſtward; the other, that, that runs by the Sauveniere, at ſome paces diſtance, to the weſtward. Each rivulet, at the loweſt, ſeems to be upon a level with the ſpring; and muſt therefore, in floods, overflow it. The ſpring riſes to the eaſtward, and at the foot, of a little riſing, rocky piece of ground, covered thinly with wood; ſuch as oak, wilding, haſel, &c. The nature of the ſoil may be judged from it's producing the common campanula, yarrow, ſtrawberries, and the great wood vetch. On the eaſt ſide of the fountane, lyes a very wet moraſs, part of which is a quaking bog or quagmire. The nature of the ſoil may be conceived from it's products; about the borders of this moraſs, alder grows; all over it, ruſhes, red rattle, marſh-marygold, ſpearwort, great moſs, &c. Yet, the quagmire being pierced, it is found no where above two feet deep, the bottom all ſtoney and clayie. The water running from this moraſs, is every where ferrugineous to ſenſible appearances and effects. To come at the well, one croſſes the Sauveniere rivulet, where a path leads turning towards the ſouth. Then, one comes to a round area, about eighteen inches lower than the path-way

or

or adjoining low ground, and about twelve feet in diameter, rudely paved with broad ſtones. In the middle of this, ſtands the ſpring, about which a little rude ſtone nich is raiſed of about two feet high, covered over with a looſe broad ſtone. All over the area and about it, there are ouzings of a ferrugineous water, which leaves a great deal of reddiſh ochre upon the ſtones, and diffuſes a pyritiſh ſmell. The baſon of the well is about two feet and an half ſquare, and about eighteen inches deep. The water ſprings ſo ſlowly, as to require about twenty minutes to fill this baſon. The water ſprings up through gravel and looſe ſtones, with a bubbling of air by intervals, not onely from the ſpring, but from the joints of the pavement of the area, and that ſometimes with a long humming or whiſtling noiſe; more in warm, and moiſt than in cold and dry weather. The hiſtory and etymology of this are as obſcure, as thoſe of any of the reſt. This water was formerly deemed purgative, and much reſorted; but, it is now much neglected.

§ 50. 8. To the north eaſt of this about half a quarter of a mile, and as it is computed, half a league eaſtward of Spa, ſtands the moſt beautiful and perhaps the moſt valuable medicated fountane to us known, in the world. This is called, the TONNELET, the little tun or barrel, from the wells having been, as is ſayed, at firſt incloſed in the body of ſuch a veſſel. The ſituation of this fountane far excels that of all the other ſprings, as it's aſpect outdoes them in beauty, and it's waters ſurpaſs any of the others, or perhaps all the reſt, in quantity, if not in quality. About it, the ſoil is more plane, even and fertile, than about any of the others. The little tract, that environs it, lyes on the north ſide of a very coarſe, high, heathy mountane, which lyes eaſtward of the Sauveniere. From this, the Tonneletis at an agreeable diſtance, and being lower, ſees onely the ſide of the aſcent, where it is covered with very beautiful trees, chiefly oak. To the eaſt of it, lye the fields and gardens

gardens of the village of Nivezè or Niveſet, to the north a deep valley, in which runs the great brook, which waters Spa. This vale, which is finely wooded, is formed to the northward, by the high ridge of mountanes, which extends to Spa, &c. which here affords a moſt magnificent proſpect. In a wet meadow, inclining to the weſt, the ſoil moory or moraſſy, for a ſmall ſpace about the well, but not above two feet deep, over a bed of white clay and ſmall, looſe, white, gritty ſtones, riſes this lovely ſpring of moſt pellucid water, with great force, accompanied with a continual diſcharge of air and a loud noiſe like ſo much bubbling, boiling water. The ſpring iſſues from ſuch a ſtoney bottom as I have juſt deſcribed. It is now confined within a ſquare wooden frame, incloſed in a nich of rough ſtone work, whoſe opening looks towards the weſt, covered over with a large looſe ſtone. The dimenſions of it's baſon are about two feet ſquare. From the ſtrength and quickneſs, with which it diſcharges it's water, ſo as to over-run one ſide of it's baſon in a full ſtream; it never requires emptying or cleaning; without which, none of the others would be fit for uſe. It is very hard to empty it, and it fills and over-runs again in leſs than eight minutes. It depoſites in it's ſtream a bright red ochre in great abundance, and a little ſtreak of the ſame at the verge of the water. From theſe a pyritiſh ſmell ariſes about the well. I found this ſpring decried by the ignorant or corrupt phyſicians of Spa; who, had they been capable of judging of the worth of this water, did not dare to recommend it; as it did not lye within the juriſdiction of their mountane magiſtrates; and uſed onely by the more wiſe and honeſt payſants. Who has moſt ſenſe of his ſide will appear from the analytical examination of theſe waters. The waters, that cauſe the moraſs in the meadow in which this fountane runs, are all ſo many ſmothered ſprings of the ſame kind of water. Theſe then might, from their ſituation, be eaſily drained to a dryneſs, were it not hazardous to injure the main ſpring. It is therefore imprudent

to attempt any thing, that might tend to obſtruct, diminiſh, or divert the ſource of the great ſpring; whileſt it's waters appear in the utmoſt perfection. While I was at Spa, I demonſtratrd the excellency of this water, and preſcribed it, to many; and having ſhewn, that it might be as advantageouſly tranſported, as any of the other waters, ſeveral ſent parcels of it to their reſpective countries. The magiſtrates of Spa growing envious of this, while it's riſing fame was yet unknown to it's owner, purchaſed it from him, in order to bring it within their juriſdiction, and ſo lay an impoſt upon this, as well as upon the other waters. If they be not barbarous enough to deſtroy it, we may ſoon expect to find ſome of their hireling ſcriblers now puffing it up moſt pompouſly. And we may find other gueſs accommodations for the drinkers, than the preſent hoſpitable neighbouring farmer's houſe affords.

§ 51. 9. Not above a quarter of a mile to the north eaſt of this, in much lower ground, and on one ſide of a very deep, wet moraſs, lyes the fountane of medicated water, called, from the chief village of the diſtrict, SAR, and ſometimes from the next neighbouring hamlet, NIVEZEE or NIVESET. This fountane is incloſed in a wooden frame about three feet ſquare and paved looſely, with ſmall ſtones at the bottom. This is covered over with a handſome, firm, ſtone nich, with this date, 1720. Around it, an area of about fiveteen feet diameter is made, which is lower by about two feet, than the ſurface of the adjacent firm ground. It is paved, and except at the ſteps, by which it is entered, is ſurrounded by a little bank, which ſerves for a ſort of ſeat in dry weather. This ſource over-runs it's ample baſon, in which the water appears very clear and bright, and diſcharges nearly as much water, as the Tonnelet, depoſiting the like ochrous ſediment in it's courſe, but none in it's baſon; except as at Tonnelet, a little upon the wood at the verge of the water. The onely convenience for the drinkers here, is a wooden cage-work hovel, which may

may ſerve to keep off ſome of the rain, and ſome of the rays of the ſun, when theſe happen to be offenſive.

§ 52. The next in order are the medicated waters of Malmendy. This is a very pretty village, in point of ſituation and buildings. It conſiſts of about a thouſand houſes, moſtly of cage-work, very large and lofty; the more modern are of brick and ſtone, of two or three ſtories high regularly and well built. Here are alſo, a conſiderable abbey of Benedictine monks, a convent of Capucins, and one of women, called, Beguines. The town is pretty regularly layed out, in two pretty large ſquares and ſeveral regular ſtreets and lanes, moſt of which have a clear ſtream of water, from different branches of the rivulet Warchien, running in a canal through them. Theſe uniting again at the end of the town, fall into the Warche.

§ 53. The ſituation of this village is extremely beautiful and commodious: For, though it ſtands in thoſe rude mountanes, called the Ardenes, it ſeems to ſuffer nothing in point of convenience or proſpect from it's ſituation. The town and the abbey are built upon the ſouth and ſouth-weſt ſide of a very lovely, lofty hill; which contributes much to the advantage and beauty of the place: For, while it fends the town from the north and north-eaſt winds, it furniſhes the inhabitants with moſt pleaſant ſloping gardens. The north-ſide of this hill is extremely ſteep; yet, covered thick with wood; which ſupplies the neighbourhood with fewel. And, at the foot of it, runs pretty rapidly, over a ſtoney and gravelly bottom, the Warche, a very beautiful, large rivulet of the cleareſt and ſofteſt water, which comes very near one end of the town, where it ſerves ſeveral bleach-yards and turns ſeveral conſiderable mills for the various purpoſes of grinding corn and bark, paper-making and fulling of cloath, and making rape-ſeed oil.

§ 54.

§ 54. From the north-weſt of this runs another, lower and longer hill, the ſouth ſide of which is partly a naked rock and partly beautifully covered with wood; and at the foot of which, is a large flat lawn, extended to the weſt of the town and bounded to the ſouth by an heathy hill: Between theſe, the Warche, the large rivulet on the north ſide of the town, increaſed by the Warchien, a ſmaller from the ſouth ſide, runs ſerpentine with a murmuring noiſe, till, at about half a league diſtant, it falls into, and loſes it's name in the Ambleve, which runs by Stavelot, Cou, &c. and diſembogues itſelf into the Maes above Liege. This lawn is bordered with gooſeberry buſhes and other ſhrubs, with roſe-bay willow weed, and in the ſeaſon, ſpangled with autumnal colchicum. On the heathy mountanes all around, the lycopodium, or club-moſs, is found in great plenty.

§ 55. One enters, the town from the north, by ſome hollow ways, which diſcover rocks of the mill-ſtone.

§ 56. All the conveniencies and neceſſaries of life are found in great plenty and perfection, at a very moderate price, in Malmendy. The inhabitants are honeſt, induſtrious, opulent, affable and ſociable; remarkably obliging and courteous to ſtrangers. They are moſt of them engaged in trade. The chief articles of their commerce are tanning and the woollen manufacture. And though their hides and wooll are brought from Buennos Ayres and Cigovia, and paſs through the hands of the Hollanders; they are able to underſel many of their neighbours for fivety leagues round them, who have the materials within themſelves, or at a cheaper rate.

§ 57. This is owing, on the one hand, to good oeconomy; the people being moderate in their deſires and frugal: On the other hand, their government, though deſpotic, is mild, and ſo wiſe, as never to impoſe taxes upon the neceſſaries of life.

§ 58.

§ 58. The monaſtery of Malmendy and that of Stavelot, which are called imperial, conſtitute a Chapter, and chooſe for their common head, civil and eccleſiaſtic, an Abbot; who, in right of this monkiſh election, becomes at once a prince of the empire and ſovereign of the principality of Stavelot, and head of the two convents; when, he fixes his reſidence at the later. They, heretofore, have been accuſtomed to chooſe their Abbot out of the eccleſiaſtics of ſome of the electoral or other princely houſes of the empire; but, at the laſt vacancy, they were more wiſe, and inſtead of a prodigal grandee, to ſpend their revenues at ſome diſtant court, choſe one of their own paiſant monks to preſide and live among his brethren, though raiſed to this high office.

§ 59. There is a great variety of moſt agreeable walks and rides about the town, with pleaſing proſpects of mountanes, woods and waters; but, nothing can give a prettier landſcape in it's kind, than the town, with the little vale, in which it ſtands, and the hills, that ſurround it, in various directions.

§ 60. Malmendy thus happily ſituate, mildly governed, ſupplied with all the neceſſaries of life, and inriched by nature with great plenty and variety of ſimple and medicated waters, lyes diſtant from Stavelot, the metropolis of the principality, one league and and half to the eaſtward; from Liege, eight leagues; from Spa, three leagues; from Maeſtrecht, twelve leagues to the ſouthward; from Aken nine leagues, to the ſouthweſt; from Luxembourg, twenty two leagues, to the northweſt, from Treves, the ſame; from Cologne, the ſame, to the weſtward; as the diſtance and points are computed by the people of the country.

§ 61. The ſoil about Malmendy is moſtly gravelly and dry; yet does it abound with many ſprings of ſimple or ſweet water, and ſome very remarkable, though obſcure, ſprings of medicated waters. I ſhall ſet down the chief of theſe in the order, in which

they occurred, and afterwards examine each apart, in the order propoſed, as near as may be.

§ 62. 10. The tenth of the obſervable ſprings of this claſs, that I ſhall take notice of here, is that, called Le Couve. Going by the Warch, on the north ſide, eaſtward, at about half a league from Malmendy bridge, a large mountane rivulet diſembogues itſelf into the Warch. This rivulet runs ſerpentine through a deep, rough valley, falling over a continued, uneven, irregular, rocky bottom. This valley, which conſiſts of many ſmaller, or extreme inequalities of ſurface, all thickly covered with wood, moſtly oak, with ſome few beech and ſome birch trees, with common underwood and ſhrubs, is called Le Trou des Marais, the Pit of the Moraſſes; becauſe the tops of the ſurrounding hills are moores or bogs, where turf is dug for fewel. Hence this rivulet is always of a muddy brown color.

§ 63. About half a league from the mouth or termination of this rivulet, after wading through the wood, by a narrow, winding, unequal, rugged, rocky path; I came to a rude rock, which partly croſſing the brook made a noiſy caſcade of about the highth of eight or ten feet.

§ 64. The rock, by the weſt ſide of which this caſcade is formed, extends and riſes to ſome highth to the eaſtward. It is a compound rock; conſiſting of layers of different ſtone; that probably ſome time might have layen horizontal, but now ſtands almoſt perpendicular. One part of this rock conſiſts of a very ſolid, ponderous hard ſtone of a blackiſh hue, veined with ſpar, and ſome parts of it are beautifully variegated with as many different colors, as the pellicule of the mineral water exhibits. Another part is compoſed of a ſoft, fiſſile ſtone or ſlate, of a blewiſh color, whoſe fiſſures are of an iron ruſt color; this is ranged alternately, but irregularly with the firſt; while between them, runs a thinner vene, of a ſoft ſtoney ſubſtance, of color and conſiſtency between black ſlate and black

black lead: It has the color and taſte of the former; but grows ſmooth and blackens the fingers upon rubbing, like the later.

§ 65. From the fiſſures of all the depending, and from ſome of the level parts of this rock, are ouzings of water, either continued or alternate, with air, which iſſues either whiſtling by itſelf or bubbling through the water. Theſe cauſe the face of the rock to have much of an ochre color.

§ 66. Here the rivulet runs from north to ſouth. On the ſouth ſide and eaſt end of the rock and eaſt ſide of the ſtream, iſſues the mineral ſpring, called LE COUVE, or POUHON DE COUVE. This flows from a little orifice in one of the fiſſures of the rock, to about the quantity a ſmall mouthed, pint bottle might diſcharge, altered now and then by an irruption of air, which flies off with a bubbling noiſe, by pretty equal intervals. The little ſtream is received into a baſon formed by a natural hollow in a ſhelf of the rock, which may hold about a gallon.

§ 67. 11. About a muſket ſhot, to the ſouth of COUVE, on the ſouth ſide of a winding turn of the river, and very near it, under the brow of an high ſteep, rocky hill, in a north expoſure, lyes the low, ſlow ſpring, called, from the next neighbouring village, BEVERSEE. The water iſſues but ſlowly, with very little diſcharge of air; and fouls it's bottom ſides and cannal with a pale ochre. A few rough ſtones, thrown rudely together, to form a ſort of baſon, ſhews all the art expended upon this ſpring.

§ 68. 12. To the weſt of the town, about a quarter of a mile diſtant, riſes a very beautiful ſpring in a moſt lovely ſituation. This is called in the Patois of the Country, LA SIGE, the ſpring in the Iſle; but why, is not known. It iſſues from the foot of the long, low ridge of rocky hills, that runs about a mile in length to the weſt of the town, partly wooded; in a fine, plane meadow, watered, by the confluence of the Warche and the Warchien; which, af-

ter turning ſeveral mills, within view of the well, run together a ſerpentine, murmurring courſe, along the verdant mead. From the town to this ſpring, there is a moſt pleaſant dry, gravel walk. And from hence, a moſt agreeable proſpect of the town to the eaſt, of an extended, and well watered lawn to the weſt. The view to the ſouth is bounded by an heathy hill.

§ 69. The overflowings of this ſpring fill all the neighbouring ditches with a light, pale ochre. It ſprings but ſlowly, and ſends up by intervals large air bubbles, as well as a number of ſmall ones, which riſe conſtantly with a ſparkling, and fly off, in warm weather.

§ 70. This is a favorite ſpring at Malmendy: The common people of the town and country drink plenty of it for ordinary drink, and they are remarkably healthy and vigorous. For the convenience of the drinkers, there is a paved area made round this ſpring, with ſteps going down to it. The ſource is covered with a neat ſtone nich, but left injudiciouſly open to the ſouth; whence, it is too apt to ſuffer by the heat of the ſun.

§ 71. Within a few yards of the preceding, riſes one of the pureſt ſprings of ſweet water in the country. It weighs no more than deſtilled water, of the ſame temperature. And ſuffers no change, upon adding twelve drops of alcaline ley to an ounce.

§ 72. 13. About half a league to the ſoutheaſt of the town, lyes the medicated fountane, called GEROMONT; about the ſoutheaſt angle of a beautiful verdant plane, ſpangled with colchicum, and watered by a purling brook, which fills ſeveral adjoining fiſh-ponds; bordered with trees and ſhrubs, roſe bay, and other willow-weeds. The ſpring riſes at the foot of a rude, barren hill, whoſe naked ſides and ſummits ſhew a gray fiſſile ſtone, ſome gritty rocks, gravel and blew clay, thinly ſet with ſtunted trees and ſhrubs, with very little, coarſe herbage; in a weſtern expoſure. It iſſues ſlowly from under large rocks,

rocks, into a large natural baſon, with continual ſparklings, when the air is warm, and a diſcharge of large air-bubbles, with a rumbling ſound, by uncertain intervals. The ſource is covered over with a ſtone nich, like La Sige, but open to the weſt. It fouls itſelf with a pale ochrous ſediment. It's overflowing water runs into a neighbouring brook, whoſe waters, in wet weather, overflow it in turn.

§ 73. The walk from the town to this fountane is moſt extremely pleaſant. It is, in the firſt place, gravelled under foot, and of courſe, clean and dry, as far as the meadow, where the well ſtands. And the paſſenger is never out of view of verdant or flowry meads, purling ſtreams and natural caſcades, wooded hills, beautiful by nature or embelliſhed by art; in ſhort, he is every where, in going to, and returning from, this ſpring, poſſeſſed of a good walk, and in view of pleaſant landſcapes.

§ 74. Though it may appear foregne to this head, it may not be diſagreeable to throw in here, what I do not purpoſe to treat of expreſsly, a remarkable petrifying, incruſting or tophous water, which riſes in ſeveral large ſprings from the ſouthſide of a riſing ground, and partly in a moraſs, between this and the Warche to the northward of that and the town.

§ 75. 14. This water is called, from the place where it ſprings, MARELIRE. It bubbles up perpendicularly in moſt places, and brings with it various odly figured ſtoney or tophous concretions. It is colorleſs and pellucid, as well as inodorous; has a kind of ſaline, nauſeous taſte.

§ 76. Wherever it lies, as it does in ſome places on the ſurface of the marſh, it leaves flakes of a tophous ſubſtance, that looks at firſt ſight like ſalt, and paſſes with the country people for ſuch: Some, having taken this water in a miſtake, being thirſty, it has vomitted and purged them.

§ 77. Strangers may be apt to do this upon finding it never froſen, when all the waters round it are firmly

congeled. The ſtream, ariſing from the overflowings of three of theſe ſprings, is ſufficient to keep the wheel of a tanner's bark-mill, on which it runs, free in the hardeſt froſt; when all the other mills in the country have their wheels fettered with icy chains.

§ 78. This water, in a phial, that held about two ounces and an half, which filled with deſtilled water weighed ſix ounces, two drachms two ſcrupules and ſix granes; weighed three granes more. It is rendered milky to opacity and precipitates a large quantity of a white earthy matter, with the ſmalleſt quantity of alcaline ley, and cauſes an ebullition with acids. But, no change with galls.

§ 79. 15. There are various other waters in and about the principality of Stavelot; but, as they do not differ eſſentially from, nor are in any inſtance preferable to, theſe; I ſhall paſs them over, at preſent, in ſilence, to procede to a moſt conſiderable medicated fountane, that has been overlooked, neglected or abuſed, by all the phyſicians of that country. I mean that, called BRUE, BRU, or CHEVRON, from adjacent villages, that ſeem each to contend for giving it it's name. Theſe lye to the ſouthward of Liege, to the northward of Stavelot; but, I can not tell the diſtance. To come at this ſpring, I went through dreary moraſſes, deſert heathy mountanes, deep vales, woods and coppice, croſſed the river Ambleve, and ſeveral great and ſmall rivulets, in a courſe, as well as I could judge, due weſt of Spa; and, in about four hours, arrived at a narrow vale, compoſed of a double ridge of hills, running eaſt and weſt, divided by a conſiderable brook. Each hill is wooded, but the northward, which is the more high and ſteep, moſtly with ſmall oak, beech and birch trees, with ſeveral ſmall ſhrubs, all poor and ſtunted; the ſoil being, for the moſt part, poor, barren, clayie and cold, brings forth but little, coarſe herbage.

§ 80. In a narrow part of this vale, where it ſeems to lye at due eaſt and weſt, after deſcending the ſlop-

ing hill on the ſouthward, not far from the brook, but much higher, riſes the moſt conſiderale mineral ſpring, I ever met with all. In the deſcribing and examining of which, I ſhall be the more particular, becauſe not onely different individuals, but whole bodies of men have expreſsly written againſt it.

§ 81. At ſeveral paces diſtant from the ſpring, a ſtranger is ſurpriſed with an hollow, bubbling noiſe, like the boiling of a great caldron of water.

§ 82. The place is fenced with a cloſe beechen hedge, incloſing, with the well, an area of between fiveteen and twenty feet ſquare, paved rudely with flat mountane ſtones; bordered round with a green turf bank faced with planks; by way of a ſeat. In the middle of this, riſes the ſpring, with great force and rapidity, and continual bubbling exploſions of air, which excites wonder and admiration. The ſource is incloſed in a ſtrong oaken ciſtern, of three feet ſquare and five or ſix feet deep; ſecured with ſtrong wood and ſtone work, on every ſide. In this ciſtern, the water riſes to the highth of four feet and upwards; with force, that would carry it much higher, were there not an opening for it, by which it runs off in a conſiderable ſtream, depoſiting a bright red ochrous earth, where it runs ſlowly, or lyes at ſome diſtance at reſt. This red mixture, the neighbouring paiſants call, Sang du Pouhon, the blood of the well.

§ 83. The ſource has a ſtrong, oaken plank cover, fixed by hinges, with a lock, to prevent the water's being abuſed or ſtolen. The former indeed is not eaſy: For, ſuch is the rapidity of the ſtream, that it muſt ſoon get ſhut of any thing light or ſoluble. And, the preventing the former is not at this time neceſſary; becauſe, though it was formerly ſent to all parts, in the place of Spa water, whoſe name the vender gave it, under the ſanction of a counterfeit ſeal of the Pouhon of Spa, from which no body has yet been able to diſtinguiſh it, at a diſtance; yet, it

has ſince been ſo artfully and induſtriouſly decried, that it is ſo far from a foregne conſumption, that the natives, who made it formerly their common and beſt beverage, are now hardly ſeen to drink of it at all.

§ 84. I ſhall not trouble myſelf or the reader with a criticiſm on the inconnected fragments, that have been induſtriouſly thrown out againſt this water. Had there been any thing ſenſible or experimental produced in that way, that had fallen under mine obſervation, I ſhould not have paſſed it over altogether in ſilence. But, they are all, tnat I have yet ſeen, invidious reflections or bitter invectives, without offering any proof of their charges. But, in this, there will be no room for wonder; when we conſider the characters of the generality of the phyſicians, that have written on the waters of theſe and other ſprings. Laying aſide their capacities, they are all, in that part of Germany, dependent on the will of the magiſtrate, for permiſſion to practice. And, as the raiſing the reputation of any one water may be found injurious to ſome particulars; where ever the greateſt intereſt lyes, there the writer is influenced or procured to write for the one, againſt the other. Procured may be thought a hard word. But, it has been notorious, that ſeveral of the practicioners about the waters of Aken and Spa have taken bribes and written what they were commanded. And if individuals might have been thus corrupted, I ſee no room to doubt, that whole ſocieties may be wrought upon by the ſame means. I ſhould be glad, it were poſſible to acquit the college of phyſicians of Liege of this foul charge. This learned body formally pronounced their ſhameful judgment on, rather againſt, the waters of Bru, the ſeventh of October 1711. To the effect following;

§ 85. "We the Doctors and Fellows of the College of Phyſicians of Liege, do declare and certify, that the waters of Chevron ſtrike a deeper tincture with Gall

Gall nuts, than that of the Pouhon at Spa, occaſioned by an acrid, vitriolic fixed ſalt, with which thoſe of Chevron are much more ſtrongly impregnated, than thoſe of Spa, which contain the ſalt of Mars, much more attemperated by the ſulphureous particles, by which it's activity is moderated. Wherefore we eſteem theſe incomparably beyond thoſe, having perceived, and daily perceiving, that the more vitriolic waters, in which the acid more evidently predominates, are not to be taken with ſafety by perſons affected with diſorders of the cheſt, catarhs or other accidents, where a corroſive acid may be hurtful."

§ 86. Let the judicious examine the weight of this grave and formal ſentence againſt theſe waters, and ſee whether it does not make more for, than againſt, them. Why this formal declaration and certificate? Spa is ſubject to Liege, Bru to Stavelot. That is enough. Had there been a College of Phyſicians at Stavelot or Malmendy, of the like temper with this, it is more than probable, they had returned the compliment in kind, damned the waters of Spa. With what face can theſe ſages condemn a water for dying deeper with galls than an other?—Is a ſolution of iron, in one water, a fixed acrid vitriolic ſalt, and in an other the mild ſalt of Mars? If the ſolvent of the iron be the ſame in each, are not both alike?—How is the action of iron bridled by ſulphur?—Or, if it be, how does it appear, that Spa water contains more ſulphur, than that of Bru?—Why is the acid condemned in one water, which is the means of impregnation of an other? Is the Chevron water hurtful in inflammatory and pulmonic caſes?—And is the water of the Pouhon ſpring at Spa proper?—Can that or any other chalybeate water be given with any degree of ſafety or propriety in ſuch complaints?—Fie upon ſuch ſhameleſs aſſociations of mercenary empyrics! I muſt think, they deſerve no better treatment: Serious arguments are thrown away upon men

men ſo void of judgement, ſo regardleſs of truth and honor. I diſdain all controverſy, as well as other commerſe, with ſuch men. But, for the ſake of truth and the ſatisfaction of the public, I ſhall ſtate this argument in the true light, in examining this water by convincing experiments, in it's place.

§ 87. 16. There is another ſpring upon the ſame principle with theſe, in a Valley running north and ſouth in the corner of a meadow at the foot of a rude rocky hill, in a weſtern aſpect. It riſes ſparkling and by intervals bubbling with air in a ſtoney bottom, by the high way and not far from a large brook. It depoſites a yellowiſh or orange colored ochre in it's courſe. It bears indifferently the name of POUHON COLLIENE, from a neighbouring village, or that of POUHON SAINT ROCQUE, from a great Convent, which lyes near it. It is not much known or regarded; but, had it been more remote from ſprings, that obſcure it, the fame of it would probably have reached further than it has.

88. Having thus given a brief deſcriptive and hiſtorical account of the places, where the ſeveral waters are found, pointing each out ſo as to admit of no miſtake in this matter, with reſpect to any future enquirer; and with a view to ſhew how patients may be accommodated at or near each ſpring; I now procede to examine the medicated waters, or ſuch of them as fall under the denomination of ſabacid and ferrugineous.

I. *Of*

I. *Of the* POUHON *ſpring at* SPA.

With a due ſenſe of Reſpect and Gratitude,
Inſcribed
To the RIGHT HONORABLE
The
EARL of CARRICK.

§ 89. POUHON being a ſlow, deep ſpring, is apt to ſhew itſelf variouſly. It may be looked upon to be in the natural ſtate, onely in cold and dry weather, when, it appears colorleſs, pellucid and inodorous; imprints a ſubacid, ferrugineous taſte, with an agreeable ſmartneſs. At ſuch times, if lifted onely out of the well, in a water glaſs, it does not appear to ſparkle. It however, covers the glaſs, on the inſide, with ſmall air bubbles, upon ſtanding, and condenſes the humidity of the air on it's outſide; ſooner or later, according to the heat or coldneſs of the atmoſphere. But, if agitated or poured out of one glaſs into another, it ſparkles; that is, emits and diſcharges a great number of theſe like air bubbles, at the ſurface.

§ 90. But, in wet or moiſt and warm weather, it carries different appearances: It's aſpect is not ſo bright, but inclines to be whea-like and turbid. It emits, or ſeems to emit, ſomething of the pyrite ſmell; ſhews fewer air-bubbles, and ſparkles much leſs in a glaſs. The nearer the ſurface, the more it ſuffers this change; the deeper, the leſs. At this time, more air-bubbles and greater noiſe, ſometimes, a ſort of whiſtling, with a kind of murmuring ſound is often heared. This the paiſants call, the ſong, or muſic of the ſpring, and look upon it as a ſign of impend-

impending rain. In this, they are right, without knowing why. This happens, when the ſpring and preſſure of the atmoſphere is broken, ſo that the included, agitated air in the water finds leſs reſiſtance in ruſhing forth.

§ 91. Theſe ſhew in what ſeaſon the water is to be found in the higheſt perfection, and in which it is moſt likely to be decompoſed or altered. And alſo point out an error, which has long prevaled in drinking of this deep, ſlow riſing ſpring, as the attendants ſkim it from the ſurface with glaſs goblets. To obviate which, and give the water in the utmoſt perfection, I adviſe the taking it up in a kind of double tubed funnel. This may be, as I have had them made for my patients, of glaſs, upon the principles of a ſeparating funnel; a bulb to hold about a pint or more, with two tubes, drawn in a perpendicular direction from it; the one about three inches, the other about eighteen inches or two feet long, with a bore of about half an inch in diameter, ſomewhat narrower, in the ſhorter tube. By holding this funnel by the longer tube, and ſtopping the orifice with the thumb, it may be immerged to any depth required in the ſpring, without admitting any water, till the opening of the ſmaller tube ſhould be ſunk ſome eight or ten inches below the ſurface of the water, which is generally thus far much altered by the air. Then, by taking off the thumb, the contained air, which before impeded the entrance of the water, will now give way to the preſſure of the heavier fluid, the water; which will be obſerved to run in from below, and riſe to the level of the ſpring. Then, cloſing the upper tube again with the thumb as before, the funnel may be lifted out of the well, full of water, which, by taking off the thumb, may be permitted to run into a glaſs or other convenient veſſel for drinking, in the utmoſt perfection.

§ 92. The neceſſity and advantage of this method will readily appear.

1. From

1. From expoſing a wide mouthed glaſs of it to the open air. In a few minutes, in warm weather, it is lined with bright, ſmall air-bubbles. In leſs than half an hour, it throws up a pale mother of pearl colored pellicule, which highthens in colors and variegations, like thoſe of the feathers of a peacock's tail; the water grows milky at the ſurface firſt and then all over; by degrees, it then grows turbid, and at length, an ochrous earth ſubſides, and the water again becomes clear, but not as bright as at the firſt. As it changes it's brightneſs, it loſes it's ſmartneſs and taſte, and other chalybeate qualities. Theſe changes are wrought ſooner or later according to the heat or coldneſs of the ſeaſon.

2. By agitating it, in a bottle about half full, ſtopping it with the thumb; after every agitation, upon opening the bottle, air, with the volatile ſpirit of the water, will ruſh out, with force and an exploſion; which, at every ſuccuſſion, will diminiſh; till, about the fourth or fiveth, it ceaſes, or becomes imperceptible. After this, it amits of it's briſkneſs and pellucidity; loſes it's ferrugineous flavor and ſmartneſs; and ſoon after, grows vapid, milky, turbid, and changes as the preceding.

3. A bottle, whether completely or incompletely filled and corked, if ſet in a warm place, will burſt, or throw out the cork, with a loud exploſion. If the later, the water, ſoon after, becomes vapid, milky, turbid, &c.

4. If a glaſs of it be placed in hot ſand or in hot water; before it ſenſibly warms, it begins to ſparkle, as if it boiled; diſcharges a cold breeze of air, and throws up little bubbles, above the ſurface of the water, in a cloſe veſſel, ſome inches. At the ſame time, a variegated pellicule covers the ſurface. In proportion as it heats, to a certain pitch, this ſparkling and boiling increaſes; then, ſoon after, it decreaſes; and then, the water appears milky or turbid, and as it approaches to a boiling heat, it becomes muddy and of

a rediſh color; the bright pellicule, tarniſhes to a ruſt color.

5. Placed, in an open glaſs, under the receiver of an air pump, upon exhauſting the air, the water has ſimilar appearances, to thoſe on the fire; as to ſparkling and boiling, abatement of it's brightneſs and taſte.

§ 93. Hence, it appears, that by expoſure to the open air, by agitation in confined air; by exhauſting the air, as well as by rarefying and expelling it, by any degree of igneous motion, the water is altered or more completely or incompletely decompoſed. Therefore, the leſs it is expoſed to ſuch changes, the more perfect it muſt be; as the more it has ſuffered by any of theſe accidents, the worſe it muſt always be rendered. The fuller it is at corking the better. This holds good of all mineral waters; which are all more or leſs decompoſed or corrupted, in proportion to the empty ſpace left in the bottles at corking. Theſe obſervations ſhew the palpable errors of thoſe, who direct their duped patients to mix hot water with their Spa, or to ſet the flaſk to warm in hot water. The mineral water muſt ever be changed by it, if the flaſk ſhould eſcape; which it can not, in the later caſe, if it happens to be well corked and in good order. So that, in all reſpects, it is groſsly abſurd. From theſe conſiderations alſo, it is eaſy to conceive how and why the water, at the ſurface of a large ſlow-filling well, ſhould be altered, as it is upon experiment found, to five or ſix inches, and in warm weather further, below the ſurface: For, to that depth, more or leſs according to the heat or coldneſs, wetneſs or dryneſs of the atmoſphere, the water of the Pouhon will be found to be ſenſibly changed, as it is in the preceding experiments.—Wherever hereafter I ſpeak of the water, without mentioning any of theſe changes, let it be obſerved, I mean the water unaltered, in the natural ſtate.

§ 94. The temperature of the water, at ſeveral trials

trials, in the months of Auguſt and September, in the year 1752. By Prins's double-tubed, pocket thermometer, compared to the Atmoſphere, as 52. or 53. to 67. and variations to 84. But, at the ſurface, it was in temperature, as well as in other reſpects, ſo altered, as to vary from 53. to 55. From it's ordinary coldneſs, it readily bedews the outſide of the glaſs, in which it is held, by condenſing the humidity of the atmoſphere.

§ 95. A phial holding, in meaſure, about two ounces and an half, which, with it's exactly ground ſtopple, filled with deſtilled water, cooled to the ſame temperature, weighed ſix ounces, two drachms, two ſcruples and five granes, Spa weight;

	ounc.
1. This phial filled with Pouhon water of the above temperature of 52. weighed, - - - - - - - - - -	6. 2. 2. 6.
2. The ſame, taken from the ſurface, when altered by the loſs of it's valatile parts, though rarefied, weighed to one quarter and half a grane more.	6. 2. 2. 6.½
3. Diveſted of it's volatile parts, by the Air pump, § 91. 5. This phial full weighed, - - - - - - - - -	6. 2. 2. 7.
4. And diveſted of theſe parts, by long and ſtrong agitation, § 91. 2. it weighed, - - - - - - - - -	6. 2. 2. 8.

§ 96. Hence, we ſee, that, while the water is replete with it's volatile parts, though evidently charged with mineral matter; it is yet, in this quantity, within a grane, as light as ſo much deſtilled water. But, being diveſted of theſe parts, the water with it's minerals, ſhew their proper gravity, though rarefied by ſome degrees of heat beyond the natural; for, the ſame volume of the ſpoiled water is found increaſed two granes in it's weight. Soon after it has been filled with the perfect water, and ſtopped, an air-bubble is ſeen, as if from loſs of ſubſtance. But, it is the volatile ſpirit and elaſtic air included, rarefi-

ed,

ed by the warmth of the circumambient atmoſphere. Let us now compare the water, in the natural ſtate, and that thus changed, by a few experiments.

§ 97. 1. With ſirup of violets, a tea ſpoonful to two ounces, the quantity of the water always to be underſtood, when another is not named; it ſhews a roſe purple, at mixture; which, inſtantly vaniſhing, leaves it of a pale blew. Then, in a minute, it changes to a ſea green; firſt at the ſurface, and preſently all over; and this gradually highthens from the ſurface downwards; till, in about fiveteen minutes, it appears univerſally of a bright green. This, by the ſame gradation, ſtill deepens to a graſs green, and appears ſo at the end of twelve hours; except at the bottom, where it is, comparatively, of the paler green. It then, bears a ſky colored, changeable pellicule.

2. The altered water, as in § 89. 91. 1. 2. 3. 4. 5. or taken at any time in moiſt, warm weather from the ſurface of the well, ſhews no ſhade of purple or blew, with this ſirup; but inſtantly, turns to a thorough green, and, in about two minutes, it is as deep all over, as 1. in ſeveral hours ſtanding.

§ 98. Theſe ſuccede alike with juice of the common corn blew-bottle. And theſe alone can leave me no room to doubt the propriety of the term Acidulae, as they give ſufficient evidence of a fine ſubtil, volatile eſſence or ſpirit; to whoſe acidity, the fleeting purple tinge is owing; leaving the liquor blew or of a paler or deeper green in proportion, as it flies off and leaves it neuter, or the iron or the alcali to predominate. This is ſufficiently evinced by the 2. which demonſtrates, that the waters ſpoiled of this volatile acid, produces none other color, than green, with the ſirup or juice.

§ 99. But, we have another evident proof of this acid, by another ſimple experiment. A piece of tournſol-dyed paper, dipped in the unaltered water, changes firſt crimſon and then to a pale red. This

is

is by no known means done, but that of acids. And it is a proof, as demonſtrative, as it is ſimple: For, this ſhews the acid in ſolutions of alum and iron, by growing red in them; while they turn the juices and ſirups of blew flowers green. It anſwers the ſame purpoſe in this; for, whileſt the water contains enough of the acid to keep the iron, it contains, ſuſpended; it changes the color of this blew paper. But, when the water is ſo far ſpoiled of this ſpirit, that the iron precipitates in the form of an ochrous earth, then it works no remarkable effect upon the paper. And then, it ſhews, firſt a blew, with ſirup of violets, and by degrees, changes to a green. Moreover the paper thus ſtained in the perfect water, is recovered in the ſpoiled water. All which, in mine apprehenſion, planely and ſimply prove, the water to be, in the natural ſtate, acidula; then, as it loſes it's ſpirit, which appears to be acid, and to predominate; it comes near a ſtate of neutraliſation; but, as this ſpirit is further diſſipated, ſalts of another, an alcaline kind, or the metal diſſolved in the water, predominate; and, acting their parts, produce the changes mentioned. The firſt green is owing to the iron; the ſecond and brighteſt, to a fixed alcali, as will appear in the ſequel.

§ 100. 1. With the infuſion of galls, thirty drops, it produces a roſe purple, not immediately, but very ſoon after mixture. In leſs than a minute, it grows deeper and turns more to the violet. This highthens gradually, for an hour or two. In about ſix hours, it appears ſo deeply charged, as to ſeem at firſt ſight, opac. But, upon a cloſer view, it appears clear and of a deep violet purple. In about twelve hours, it coagulates, and the coloring matter ſeparates and ſubſides. A ſmaller quantity of the infuſion produces the like tincture; but, it ſooner coagulates and precipitates the coloring matter.

2. This in the water taken from the ſurface of the well, or after it grows ſomewhat turbid by ſtanding,

ſtrikes a deep crimſon, tending to a claret color, upon mixture. And,

3. With water, further ſpoiled by agitation, till it ceaſes to explode, or by the air pump, it ſtrikes inſtantly a deep violet purple.

4. After the water has been heated, or ſtood long enough for the metallic parts to ſeparate and ſubſide; it loſes it's ferrugineous taſte and ſmartneſs, and with that, it's faculty of tinging any ſhade of purple, blew or black with galls, or their infuſion. For this decompoſition, it requires from twenty four to forty hours, according to the heat or coldneſs of the air to effect it completely. But,

5. If a ſufficient quantity of the volatile or fixed acid of vitriol be added, taking care, it ſhould not predominate; the metallic particles precipitated will be rediſſolved; the water will recover it's pellucidity, ſmartneſs and taſte, and will tinge the purple and violet color, it did at firſt.

§ 101. From theſe, we learn, that this water is charged with iron, by the means of a mineral acid; which, tending to predominate in the 1. prevents it's ſtriking the dye inſtantly. When this ſpirit is, by any means, ſlightly diſſipated, as in 2. the color ſuccedes better. When it is yet further diveſted of the ſuperabundance of this acid ſpirit, the color ſtill more readily and effectually ſuccedes, as in 3. But, if it be entirely diſpelled or diſſipated, as in 4. the water is diveſted of it's metal, with it's ſolvent ſpirit; for, the one precipitates, as the other exhales; and being no longer in a ſtate of ſolution, the ſubtil precipitation, by the means of the galls, can no longer be brought about. This accounts for the coagulation and precipitation in the 1. But, if to the decompoſition or precipitation, 4, a ſufficient quantity of an analogous acid be added; the loſs is in ſome meaſure retrieved; as in 5. and the taſte, ſmartneſs and tinging quality are reſtored. If further proof of a ſolution of iron, in a ſubtil acid be wanting; let clean

clean egg ſhells be ſet in the water, and the air-bubbles will be found to adhere to them, in part to diſſolve them, and leave the particules of iron, in the form of ochre in their places. Which ariſes from a ſtronger affinity or attraction, between this acid and the abſorbent, than between it and the metal.

102. That this is the etiology of this impregnation will be explaned upon conſidering, that the ſtrongeſt unſaturated ſolution of iron, or that, in which the acid ſolvent predominates; there can be no precipitation or coloring produced by galls; till the acid be by ſome means diminiſhed or ſaturated. And that, after the deepeſt color is produced with galls and a ſolution of iron, it is again deſtroyed by making an acid predominate; that is, the precipitated iron, as well as the precipitant galls, are both rediſſolved by the acid. Then, let this acidity be blunted by any abſorbent, or rather by a fixed alcali, and the priſtine purple, blew or black color is preſently reſtored: Upon theſe principles, the impregnation of this water and the means of explaning it, to me, ſeem founded. This ſhews the abſurdity of the notion of a volatile iron or ſteel or of a volatile vitriol; agreeable to the note on § 61. of the introduction.

§ 103. But to evince the truth of this doctrine by further experiments: I threw ſome clean new filings of iron into a glaſs of the water, about a tea ſpoonful to half a pint; with a view to ſaturate the ſeeming redundant acid. I was not diſappointed: For, inſtead of the water's ſparkling or otherwiſe throwing off the included air and acid ſpirit, both were attracted by, and collected upon, the iron. By this, an extraordinary kind of inteſtine motion was produced: The action of the acid upon the particules of the iron, expanded the globules of air, by which they roſe ſlowly to the ſurface of the water, each loaded with ſome portion of the comminuted metal. Theſe loaded air-bubbles partly exploding at the ſurface, the, before, buoyed up iron, now, preponderated; and having got a-

gain to the bottom, there remaned; till the inveloping air-bubble was again expanded or otherwiſe enlarged; then, it floted to the ſurface; till the air, being partly or entirely, diſcharged there, the iron precipitated, by it's own gravity, as before. And thus, a continual rotation or motion, of aſcent and deſcent, was ſupported for ſeveral hours. Some of the filings, as they riſe to the ſurface adhere to a thick pellicule, which is ſoon formed there. And ſome adhere to this, pendent in little globules of air. All which exhibit appearances moſt pleaſing and entertaining to the curious.

§ 104. The manner of this water's acting upon the iron leaves no room to doubt of it's being charged, ſuperabundantly, with an acid. After the iron and the water had ſtood thus together for about an hour, it was rendered ſenſibly more ferrugineous to the taſte, and tinged more ſuddenly and deeply with the infuſion of galls, than in the natural ſtate.

§ 105. 1. To aſcertain the effects of this experiment, I put ſeveral parcels, of half an ounce of the filings of iron, in ſeveral wide-mouthed quart bottles of the water, and left them open for ſeveral days. It was ſoon covered with a thick pellicule; which, upon breaking, readily fell to the bottom. I tried one or other of theſe, one way or other, every day, from the firſt to the fiveth; and found that each day it tinged more readily, as well as more deeply, with the infuſion of galls, than it did in the higheſt perfection at any time at the ſpring. But the coloring matter coagulated and precipitated ſoon after mixture. And, in about eight days, the diſſolved iron was ſo effectually precipitated, by the eſcape of the mineral acid, that it loſſed it's purple tinging faculty. Not having conſtantly tried it, I can not aſcertain what day between the fiveth and the nineth, this infuſion loſſed this tinging quality entirely.

2. Upon filtrating a bottle of this infuſion, it taſted ſtrongly ferrugineous, and readily ſtruck the dye

dye with galls. It was quite bright at running through the paper; but, very ſoon after grew milky, and not long after, became turbid, and let fall a dark, rediſh ſediment; and then, tinged no more with the infuſion of galls.

3. Another, after filtration, I evaporated to a dryneſs. As ſoon as it was heated a little, it grew quite turbid, of a yellowiſh or ochre color firſt, and then darker. This ſoon ſubſided, and grew ſtill darker, as the liquor exhaled. Being evaporated to a dryneſs, a brown, umbre colored powder lay at the bottom, which weighed about ſix granes. Over and around this, lay a kind of an extract, to the quantity of ten granes, of a tenacious conſiſtence, and darker color; of an auſtere, bitter, ſaline taſte. It was not ſoluble in water. But, cauſed an ebullition and partly diſſolved in the mineral acids.

4. I weighed the half ounce of filings of Iron thus infuſed, after having dried it well. It loſſed ſix granes of it's weight. It is obſervable, that the longer it ſtood in the water, after three or four days, the leſs the weight ſeemed to diminiſh. Becauſe, though there might have been ſome ſolution, after that time, there was alſo ſome precipitation. Thus, at the end of eight or nine days, the water ſtanding on the filings was fine and bright, but inſipid, and ſtruck no color with the galls. Theſe filings, being then dried and weighed, the ſame quantity of ſolid matter, that was put in, was found, partly reduced to the form of fine ruſt of iron, and increaſed by above a grane, from the martial earth of the water joined with it.

5. Theſe conſidered, what room is there to doubt the propriety of the term acidulae? The exiſtence of a ſubtil, volatile acid in this water, which attacks the iron, inſtead of flying off with the air, § 105. 1? which diſſolves, and ſaturates the water more ſtrongly with the iron, 2. 4? And which is ſo ſubtil as to fly off from the ſame ſolution, as it does from the water, 3. 4? The extract, in 3. I take to be the

oily matter in the water, with the pellicule, which it throws up, uniting with ſome portion of the iron and the ſaline parts of the water; which will appear to be alcaline, by following experiments.

§ 106. The ſpirit of ſalt ammoniac, with quick lime, to fiveteen drops, cauſed a pearly milkineſs, with a yellowiſh hue; but no commotion; on the contrary, the natural ſparkling of the water is prevented. In about two hours, the milkineſs coagulated, and formed light, floting clouds, which, towards the ſurface, tended moſt to yellow. After twelve hours, the clouds were partly precipitated and partly ſuſpended; the color becoming deeper, as they coaleſced, and the ſupernatant fluid becoming colorleſs and bright, without throwing any pellicule to the ſurface.

§ 107. With ſpirit of ſalt ammoniac, with a fixed alcali, in the ſame proportion, the like effects, as in the preceding, were produced. With theſe differences; that the natural ſparkling was not onely prevented, but a ſlight, ſlow ebullition enſued, and a light mother of pearl colored pellicule covered the ſurface.

§ 108. With the alcaline ley, as far as fiveteen drops, it grows milky, at every drop, and precipitates in opac, white clouds, an heavy white magiſtery; over which, ſome lighter clouds hang, whoſe upper ſurfaces ſhew a pale brown or yellow. The ſurface was covered with a pale mother of pearl colored pellicule; and upon ſtanding, two different precipitates were viſible; one lying, like a pearl colored, heavy, gelly-like ſubſtance, at the bottom; the other, in lighter, yellowiſh clouds over it, and partly diſperſed throughout the liquor. The former will appear to be the terrene parts, the later, the iron. It is obſervable, that at or after the mixture of this alcali with this water, there was no ſenſible ebullition, or ſuch like commotion. On the contrary, the natural ſparkling of the water was obſtructed, wherever the ley mixed;

mixed; ſo that, upon pouring the water into the glaſs, into which the ley had been dropped, no ſparkling or other ſeparation of air enſued. The water, thus ſaturated, yields a particular priſmatic, cryſtalline ſalt, of a bitter, nitrous taſte and appearance, which hardly ſtands the humidity of the air; parts with a ſubtil volatile fluid, by the affuſion of the ſtrong acid of vitriol, and by fire. Which ſhews the temporary union of a moſt volatile, acid fluid with a fixed alcali[a].

§ 109. This at firſt ſight might ſeem to argue a kind of contradiction to the notion of Acidulae. It is indeed, contrary to the effects produced upon the mixing ordinary acids and alcalies. But, when the extraordinary ſubtility and levity of this acid, and the gravity of this alcali are conſidered, it will not be wondered, that the one is abſorbed by the other, without any viſible commotion, as is perceived with the lighter alcali, § 107. This perhaps beſt ſhews the difficulty of aſcertaining the limits betwixt alcalies and acids. It is probable, that where the acid ends, the alcali begins, or where the alcali ends, the acid commences; and that of all others, this is the acid, that approaches neareſt the nature of an alcali. But, that there is an evident acid, in this and the like waters, is demonſtrable from this, among other conſiderations; that it is charged with one or more different earths, and that theſe earths are precipitated by alcalies; which could not have been, had the impregnation been wrought by alcalies; for then, acids muſt have proved the proper precipitants; which experiments contradict. This ſubtil fluid, which has already been ſhewn by preceding experiments[b], and ſhall again be further evinced in the ſequel, I take to be the volatile mineral ſpirit of BECHER and others[c], and the moſt ſimple and ſubtil acid known in art or nature. That, that beſt deſerves the appellation of ſpirit, and

[a] See § 316. [b] § 97. 1. to 105. [c] P. I. § 171. P. II. § 29, &c.

that, on which the principal efficacy of theſe and all ſuch like waters depends. Let us now go to the other extreme, and ſee the effects of acids on this water.

§ 110. All the Acids, whether mineral or vegetable, from the ſtrong acid of vitriol, to the lighteſt, deſtilled vinegar; cauſe a quick, ſmart ebullition with it, from the firſt drop, till long after the added acid ſenſibly predominates.

§ 111. This would ſeem another contradiction to the former obſervations [a], intimating an acid to predominate in this water. And this, as well as § 97, is by ſome offered as a proof of this water's being purely alcaline; and conſequently, as an argument, that the term Acidula is abſurd. But, theſe are inaccuracies, that rather confirm, than contradict my notions: The contraſt here, between the added acid and the water, does not ariſe ſo much from the conflict betwixt them and the alcaline ſubſtance in the water, as upon the expulſion of this light, ſubtil, upon the intromiſſion of an heavier, groſſer, acid. This will more clearly appear, by the two following experiments.

§ 112. 1. The water being diveſted of it's air and ſubtil ſpirit, by expoſing to the open air, by agitation, or the air pump; it cauſes no ſenſible ebullition with the lighter, and very little, with the heavier, acids; compared to the firſt, § 110, none. Were an alcali alone the cauſe of the contraſt, the ebullition might now be greater, the ſubtil mineral acid having eſcaped. But, that this may not prove an argument of the mineral, volatile ſpirit's being, as ſome would contend, alcaline; the phaenomenon may be explaned by an other experiment.

2. Let any of the lighter, ſpirituous acids be charged with any abſorbent earth, or a volatile or fixed alcali; ſuch as the acids of ſalt or nitre, with chalk, volatile ſalt of hart's horn, or ſalt of tartar, for example; with any of theſe ſolutions, which can not be alcaline, or with the ſaline mixture, though the a-

[a] § 107. 108. 109.

cid

cid planely predominates; let the water be ſlightly charged. Into this impregnation, let the ſtrong acid of vitriol be dropped, and an ebullition will preſently enſue. This conflict ariſes, not ſo much from a contraſt between this acid and the abſorbent earth, which can be no longer in that ſtate, after ſolution in any acid; nor with the alcalies, overcome by acids; as from the ſtronger attraction, or greater affinity of the vitriolic acid to the abſorbents and alcalies; whence, it uſurps the place of the lighter acids, and propels them. This appears to me exactly parallel to the effect, that all our groſſer acids produce in this water: They propell the lighteſt and moſt ſubtil of all acids in the water, and uſurp it's place. From this, an uſeful practical caution is to be deduced: Not to give acids, as is too frequently the practice, particularly the Elixir of vitriol, with the water; which upon mixture, diveſts it of it's native, inimitable acid, ſubſtituting ſuch a groſs artificial one in it's place, as totally changes it's nature. The ſame reaſon will hold good againſt all other acids, and againſt aceſcent food and beverage, of all kinds.

113. 1. The ſolution of ſope, dropped into this water, grows milky and grumous, at every drop; and ſoon after, coagulates, ſeparates, and is as completely decompoſed, as if dropped into water overcharged with any groſſer acid. This, can onely be accounted for upon the principles before inculcated. Nothing but acids thus decompoſes ſope. This ariſes from the ſtronger attraction or affinity betwixt the acid and the alcali, than betwixt the oil or fat in the ſope, and that ſalt. Whence, the ſalts unite, and the oil ſeparates and ſwims. There can not then be a ſimpler or a clearer proof of an acid, than this. But it is rendered ſomewhat planer by a negative one;

2. If to the water ſpoiled of this volatile ſpirit, as in § 92. 1. 2. 3. 4. 5. the ſolution of ſope be added; it mixes more or leſs ſmoothly, in proportion as the water has been ſpoiled. This ſhews planely, that what

what the water loſes in theſe operations, it's ſubtil mineral ſpirit alone, is the cauſe of this decompoſition of the ſope; conſequently, this ſpirit is an acid. Hence, ſome uſeful practical cautions may be drawn: This ſhews the miſtake of thoſe, who give ſopes with this and ſuch like waters. One or both the medicines muſt be ſpoiled. And then the effect depends upon that, which predominates, or upon a neutrated ſalt and oily matter, which may with greater certainty be produced otherwiſe, without ſpoiling this excellent water.

§ 114. Notwithſtanding the preceding and various other proofs of acidity to be given, this water works no perceptible change upon milk, than dilution, whether mixed with it cold, warm or boiling hot.—Another proof of the extreme ſubtility and volatility of this mineral ſpirit. This alſo gives us aſſurance, that this water agrees with milk. The world is indebted to the great HOFFMAN for this happy, practical obſervation: This teaches us, that milk of all kinds may be properly given with a courſe of theſe waters. I have known them make milk agree with ſtomachs, that could not bear it alone. And, on the other hand, I have found milk ſo ſoften and moderate the operation of the water, as to render it agreeable and ſerviceable, where it could not otherwiſe be borne; as in thin, hot, arid temperaments, and in ſome hectic caſes, where, the gaſtric juice was defective or diſtempered.

§ 115. From theſe trials, we proceede to thoſe with metallic ſolutions; which are variouſly affected by this water.

§ 116. The ſolution of corroſive ſublimate, as far as twenty drops, cauſed an ebullition, and diſcharge of air, at dropping; but, none other perceptible change. In about two hours, it appeared covered over with a ſlight mother of pearl-colored pellicule, and the glaſs, ſet with air-bubbles. The pellicule grew thicker upon ſtanding, the colors more confuſed and blended, as it were by agitation. The liquor

now

now appeared ſomewhat milky and turbid; but, upon decanting, it proved clear; the glaſs being thinly covered with a pale, brown precipitate, ſlightly adherent to the ſides and bottom.

§ 117. Here is no very poſitive appearance of any thing alcaline: Otherwiſe, we ſhould have had a precipitation of an other color and form. This however, may, in ſome meaſure, be reckoned upon. The reſt, I take to be none other, than the martial earth of the water, which in the time might have precipitated, in an other manner, by it ſelf.—See Idea of ſalts and trial and choice of ſimple water.

§ 118. 1. The ſolution of mercury in the acid of nitre, as far as ten drops; every drop ſhews a bright white cloud, with a diſcharge of air, and inſtantly changes to a pale lemon color; then, gradually ſubſides. As the drops fall in, they leave a pellicule of the color of tarniſhed ſilver on the ſurface, whoſe lower ſide appears black. In ſome hours, an other pellicule, of a changeable roſe purple, ariſes. The upper part of the glaſs is ſlightly coated with a pale earthy matter, which makes the liquor look turbid. This ſhews two other precipitates; the one of a pale, the other of a deeper lemon color.

2. If the water be poured upon the drops, or they be otherwiſe mixed upon dropping; the changes are more ſudden, and the precipitates appear, the lower yellow, the upper tending to orange color.—If the water be ſpoiled, none ebullition with any of the metallic ſolutions, more than the acids, is ſeen.

§ 119. This decompoſition of the mercurial ſolution is wrought partly by the ſolid contents of the water, partly by their ſolvent, the ſubtil mineral ſpirit; which appears to be vitriolic, from the yellow color, it gives the mercurial precipitate.

§ 120. The ſolution of lead in deſtilled vinegar, to ten drops; cauſed a blewiſh milkineſs at every drop, with an increaſe of ſparkling; upon mixture, it aſſumed a pearl color: ſoon after, put on a milky opacity,

city, and then, a fair white magiſtery gradually ſubſided. In leſs than two hours, the precipitation is completely effected. In ſome hours, a pellicule of the color of a pea-cock's neck, much upon the blew and green, is formed upon the ſurface. The precipitate, at bottom, is of a pure white; while, over it, lye ſome clouds of a pale brown, and the glaſs, above them, is ſlightly coated of the ſame color.

§ 121. The ſolvent and ſolved both concur in producing theſe effects in the water. The volatile ſpirit precipitates the lead, of a ſnow white. This falls from it's gravity the loweſt, and is ſoon after followed by the metallic and terrene parts of the water, which appear in the above mentioned clouds and coating.

§ 122. The ſolution of ſilver, to ten drops; at every drop, a conſiderable milkineſs, with a ſmart ebbullition, aroſe. Upon mixture, it acquired a pearl opacity all over. It ſtood two hours, without any ſenſible change. Viewed after twelve hours, it appeared of a pale purple hue, mixed with white; with a ſky colored pellicule, ſullied with dark ſpots, on the ſurface. Upon decanting, the liquor was found clear; the bottom and ſides of the glaſs were coverd with a dark ſlate-colored precipitate, and over it, a pale aſh-colored one, which mixed with it. Theſe, when dried together, gave a very ſubtil powder, of a pale purple.

§ 123. This is to be accounted for in the ſame manner, with the changes with the ſolution of lead, § 120, 121; the ſolvent and the ſolved in the water are each capable of cauſing a precipitation of the ſilver; which would be colorleſs or white, with any but a vitriolate precipitant; this I have obſerved generally to give the ſlate color or purple caſt to the precipitate, whether the water be impregnated with iron or not. And to this, I think the precipitation is partly, and the color principally, if not ſolely, to be attributed.

§ 124.

§ 124. With intent to examine this volatile ſpirit apart, if poſſible, I charged a cucurbit with ten pints of the water, leaving an empty ſpace, of eight or ten inches, in the neck. I placed it, with all expediton, in Boerhaave's [a] wooden furnace, and adapting it's head and recipient, and luting the junctures, with the glare of an egg, flower and paper, as expeditiouſly as poſſible, I gave it fire gradually. i. It ſparkled and bubbled with a crackling noiſe, and all the appearance of boiling, long before the glaſs was ſenſibly warmed. ii. Each air-bubble roſe from the bottom, with ſuch force, as to fly, inveloped in a portion of the water, ſome three or four inches, or more, above the ſurface of the thus boiling fluid; and, the air and ſpirit then eſcaping, the particules of water fell back again upon the maſs, in form of a little ſhower of rain.—If the water be ſet immediately upon the fire in any open veſſel, theſe ejected bubbles will be more apparent, and if viewed in the ſun beams, a little miſt will be ſeen, for ſome ſeconds, over the ſurface of the water, from whence a cold air will be perceived to iſſue, though the water be growing warm. This ſhews the neceſſity of uſing an high deſtilling veſſel; for otherwiſe, the mixed water, in theſe bubbles or miſt, might tranſcend the helm, and deceive us in, if not fruſtrate, the operation. iii. This ſparkling, bubbling and ſhowering continued, till the water came near a boiling heat; and, after it once acquired that heat, they ſenſibly decreaſed. iv. By this time, the water in the cucurbit was in ſome meaſure decompoſed; it grew firſt milky, and by degrees more and more turbid; and, at length, quite muddy, of a brown color. v. Before it came to this, a diverſicolored pellicule aroſe and covered the ſurface. But, it's brightneſs, as the heat increaſed, was tarniſhed to a ruſt color; and, as the liquor boiled, it broke and ſubſided. The glaſs, at the ſurface of the liquor, was coated with ochre. vi. In the deſtillation, it exhibited nothing ſenſibly different from ſimple water:

[a] Elem. chem. T. 1. p. 886.

No

No ſtriae or little venes, but dewy drops in the head and recipient. When about an ounce had deſtilled, I found, it had no remarkable ſmell or taſte. I then examined it by mixtures;

1. With ſirup of violets, it ſtruck inſtantly a roſe purple; which, in leſs than a minute, vaniſhing, left it of it's natural color and continued ſo.

2. Blew paper, infuſed in it, became purple, and the water got a crimſon dye; but, upon ſtanding a few hours, the paper recovered it's priſtine color nearly, and the tinctured water altered to purple.

3. A ſolution of ſope was ſomewhat curdled.

4. It ſeemed to cauſe an ebullition with a ſolution of a volatile alcali.

5. Turned milky, with the ſolution of ſilver, and

6. The ſolution of lead produced the like effect.

7. Upon repeting the deſtillation, I layed ſome ſlips of the blew paper in the junctures; and had them always ſtained with ſeveral red ſpots.

8. The remaning liquor filtrated, ſtruck but a blew and then a green, with the ſirup of violets.

125. All theſe, to me, afford inconteſtible proofs of an acid, of extreme ſubtility, almoſt incoercible. For, it is continually eſcaping from the natural water; and the water, with which it deſtils, loſes it entirely in a few hours; ſo that, though cloſe corked, it produces none of the preceding effects, after ſtanding ſome time. And, after protracting the deſtillation beyond two or three ounces, it's effects are quite imperceptible in the ſucceding parts.

§ 126. If this water had, as ſome vanely imagined, contained that creature of an heated brain, Vitriolum Fugax, Volatile Vitriol, or Volatile Steel or iron, we might have layed traps and have ſought to catch it, in this deſtillation, as ſome of our ingenious chemical writers have attempted. But, it is enough, we have thereby ſhewn the ſolvent volatile; we ſhall find the ſolved, where it ſhould be, when the ſolvent has flown off; in the remanes. This now, appears

appears foul and muddy; upon letting it ſtand, it clears by ſubſidence, and a bright brown, ſubtil earth lyes at the bottom. This diſſolves again in any acid. By the vitriolic, for example, the purple-tinging quality is reſtored, as before. This then, is a martial earth, ſubſiding by it's own gravity, upon the loſs of it's ſolvent.

§ 127. If ten pints of Spa water be heated in a glaſs veſſel, to the degree of boiling; and after it cools, filtrated; the metallic parts, firſt ſeparating and ſubſiding, as above, remane in the coffin. Theſe, after being well waſhed with deſtilled water, are in the proportion, as it appears when dry, of about ten granes; that is, one grane in a pint. Here then, is the iron, that ſome would have thought volatile, or a volatile vitriol. That it is iron appears from theſe; 1. After torrefaction, it is attracted by the loadſtone. 2. Cemented and fuſed with any fat or combuſtible body, it yields perfect iron. 3. Mixed with ſalt ammoniac, by ſublimation it yields fair martial flowers; which, as well as the reſiduum, give martial tinctures, as the filings of iron treated in like manner would do. 4. The later alſo runs in the air and gives the Lixivium Martis of the London Dipenſatory.

§ 128. The filtrated liquor is now tranſparent and colorleſs, quite void of iron and every thing ferrugineous: 1. It ſuffers no change with galls; becauſe, the iron precipitated upon the loſs of the acid ſolvent, is ſeparated in filtration; but grows milky; and, after a while, greeniſh, upon ſtanding; from the abſorbent and alcaline matters remaning. 2. It ſhews, firſt a blew, and ſoon after, a green, with ſirup of violets; for the above obvious reaſons; the acids being gone and the abſorbent and alcaline parts onely remaning. 3. But, ſhews no viſible commotion, with artificial acids, which it did, while it poſſeſſed it's native acid. It is now onely charged with the more fixed, terrene, non-metallic, parts, and the more fixed ſalts of the water, to be next demonſtrated, by evaporation.

§ 129. Ten pints of Spa Pouhon water, ſpoiled

by

by fire of it's volatile ſpirit, after ſeparating the martial earth by filtration ; being ſet in a flat glaſs, in a gentle heat of ſand, to evaporate, 1. appears full of thin, light, bright, ſhining ſpangles or minute flakes, like flowers of benzoin. 2. Part of theſe riſe to the ſurface, and form a ſky colored, ſalt-like pellicule there ; which, by degrees, grows thick, tenacious and rigid ; being looſed round the edges, it may be turned about or taken off in large, pellucid flakes ; it muſt be broken, and ſet to ſubſide ; otherwiſe, it obſtructs the evaporation. 3. Soon after, this is ſucceded by an other, which muſt, like the preceding, be broken and thrown to the bottom. And thus, one pellicule ſuccedes an other, till the whole is reduced to a dryneſs. 4. The liquor, as it is reduced to about an eighth or tenth, appears of a pale, white-wine color. 5. When finiſhed, the ſeveral dejected pellicules lye in ſcales one above an other ; the uppermoſt, white and ſhining ; around theſe are circles of a darker colored matter. 5. Well dried, they weighed together twenty granes. 6. The flakes and pellicules are all inſipid, and grit between the teeth ; being quite inſoluble ; the ſelenite. 7. what formed the circles round the center and lay under the flakes at bottom, was ſalt, acrid and lixivial, and readily deliqueſced in the air.

§ 130. Theſe twenty granes, the terrene, non-metallic and ſaline contents of ten Spa pints of the Pouhon, waſhed with half an ounce of boiling deſtilled water, gave the color of canary wine. This being decanted, as much more was added, and it was held over the fire, till it acquired a boiling heat. This was decanted like the firſt, but was more ſlightly tinged. This waſhing was thus repeted to a fourth time, and being found to impart nothing ſenſible to it, all the waſhings were, one after an other, thrown into a coffin of filtrating paper, weighing twenty nine granes, placed in a glaſs funnel, and ſet in a clean phial. When all the liquor was paſſed, by which the remaning matter and the coffin was well waſhed ; theſe

ſeveral

ſeveral waſhings mixed, appeared of the color of mountane wine. Compared to the reſt, in this reſpect, this appeared but the third.

§ 131. This ſolution, evaporated to a dryneſs, 1. grew higher and higher colored towards the concluſion. 2. Shewed no pellicule; but, towards the verge of the ſolution, near the end of the evaporation, ſome minute ſaline ſpiculae ſhot; and 3. The whole, when ſlowly evaporated to a dryneſs, had ſeveral ſtreaks or ſpots of a pale brown upon it, evidently the oily, coloring matter, common to all waters; and appeared ſhot into cryſtals of the form of the mineral alcali or ſalt of ſoda. Being afterwards well dried, it weighed nine granes. It gives a yellow tincture to alcohol. This quantity expoſed for thirty ſix hours to the open air, it increaſed in weight three granes; which makes it probable, this is the weight of all the pure alcali, this proportion contains, and which abſorbs it's own weight of humidity from the air, with which it deliqueſces.

§ 132. This ſolution, § 130, or that of this ſalt, § 131, 1. is to taſte acrid and lixivial; the ſalt is ſtronger ſo, and bitter; 2. it changes ſirup of violets green; 3. it is not altered by alcaline leys; and 4. cauſes an ebullition with all acids. 5. Precipitates all metallic ſolutions in acids; particularly gold in aqua regia; with which, it gives aurum fulminans.

§ 133. The ſtrong acid of vitriol dropped upon the dry ſalt, § 131; it cauſed a briſk effervеſcence and emitted a pungent, volatile, inviſible exhalation, that ſtruck the noſe with a quick, but not an offenſive ſmell. The like ariſes upon committing it to a crucible in a naked fire; in which it readily fuſes, and by which, it becomes more white and acrid; by the loſs of the oily matter, with ſome portion of the volatile acid that adhered to it. And, being ſaturated with the vitrolic acid, gives the vitriolate or Glaubar's ſalt. This then, appears to be the native mineral, alcaline ſalt; to which, ſome portion of the ſubtil, volatile

acid of the water adheres, and helps to give it a cryſtalline form. This, I take to be propelled, by the heavier acid of vitriol, as well as by the force of fire; but, ſo exceding ſubtil, as to eſcapè every ſenſe, but the ſmell. If it contains any of the native vitriolate ſalt, it is very hard, if poſſible, to ſeparate and ſhew it in this ſmall quantity.

§ 134. The coffin, through which the waſhings of § 130, were paſſed, weighing twenty nine granes, after waſhing and drying, weighed forty granes; the increaſe, eleven granes, being the terrene parts. Theſe, 1. cauſed an ebullition with all, but moſt with the mineral acids; but 2. did not entirely diſſolve in any. And, 3. calcined, gave lime. But, this is no proof of their being all of a calcarious or abſorbent nature. In order to determine the nature and proportion of the earths, in the waſhed maſs, left in the filtrating coffin,

§ 135. I took five granes of the reſiduum, threw it into twenty drops of the acid of ſalt. A frothy ebullition roſe and ſoon after ceaſed. I dropped more water into it and revived the ebullition. Upon it's ceaſing, I dropped in more water, and finding no commotion, but, on the contrary, ſome ſcaly particules ſubſiding, I added more ſpirit of ſalt; finding no more appearances of the action of ſolution, I diluted it ſufficiently with water, and paſſed it through a filtrating paper; in which, I found it depoſited about two granes of a terrene foliaceous or ſcaly ſubſtance, which I found inſoluble in water and acids, and unalterable by fire; therefore, a ſelenite. The waſhings of the ſolution in the muriatic acid, were an oleum calcis ſalt ley or bittern; for, by alcaline ley, the abſorbent earth was precipitated in form of Magneſia alba, and with the vitriolic acid, it formed an other ſelenite.

§ 136. Let us now ſee the compoſition of this water, by the teſt of the preceding experiments; from whence we may deduce the following inferences by

way of Corollaries. Every pint of this fluid, in the natural ſtate, contains, with the common element water, Firſt, a ſubtil, ethereal fluid, which flies off with the elaſtic air; and, as it eſcapes, leaves the water more or leſs vapid. § 92. 1. 2. 3. 4. 5. That this fluid is extremely light, as well was volatile, is ſhewen by the water ſpoiled of it, being, volume for volume, heavier than the water in the natural ſtate; § 95. 1. 2. 3. 4. That this fluid is an acid, contrary to the opinions of ſome reſpectable men; particularly HOFFMAN; appears by § 97. 1. 2. § 98. 99; the quantity not yet, if at all to be, determined. Secondly, that it contains iron, of which this ſubtil ſpirit is the proper and ſole ſolvent in the water, is evinced by § 100. 1. 2. 3. 4. § 103. 105. 1. 2. 3. 4. That, the water is impregnated, onely by the means of an acid, with different earths; appears from the precipitations occaſioned by alcalies volatile and fixed, § 106. 107. 108. This, on the other hand, is proved by the intimate union of acids with the water; § 110. 111. 112. 1. 2. as the acid is further demonſtrated in the decompoſition of ſope, § 113. 1. as well as by the precipitations of lead and ſilver, § 120. 122. and by the effects in deſtillation, § 124. 1. 2. 3. 4. 5. 6. 7. The proportion of the iron is demonſtrated to be one grane in a pint, § 127. Thirdly, the reſt of the fixed contents of the water are in proportion of two granes to a pint, § 128. 4. Near one half of this is a mineral alcaline ſalt; the reſt, an earth; of which, about two parts in five are ſelenite, the reſt abſorbent earth, with ſome portion of oily matter, § 129. 130. 131. 132. 133. 134. So that a pint of the Pouhon water of Spa, beſides more of the ſubtil acid than is neceſſary to ſuperſaturate ſomewhat leſs than a grane of mineral alcali, and ſomewhat more than a grane of ſelenite and abſorbent earth, contains more of the ſubtil volatile acid than diſſolves moſt perfectly a grane of iron; which is ſo far from being related to volatile, that it is demonſtrable by a great variety of ex-

periments in the water, after the volatile vitriol-catchers think it flown: So that, from it's ceaſing to tinge with galls, it will be found precipitated, as it is in the courſe and bottom of the ſpring, in form of an ochrous earth, as well as in veſſels, in which it is ſet to ſtand; and even after evaporation of the water to a dryneſs; but then, mixed with the other ſolid contents.

137. To what then are we to attribute the medicinal virtues of this famed ſpring?—What ſhould we expect from the fixed contents of ten pints of this water? Nothing ſurely, equal to what one pint of the water in perfection produces. The fixed ſolid contents, by any known preparation of art, could produce none of the effects, wrought by that ſolution of the aggregate in the water, by the means of that moſt ſubtil exalted fluid, the work of the ineffable and inimitable chemiſtry of nature. But, as all the waters of this claſs are impregnated, upon the ſame principles, with ſimilar ingredients, I hold it beſt to view the analyſis of each apart; and then, to make a compariſon, and explane their medicinal operations and effects. For this purpoſe, I ſhall take the other fountanes of this diſtrict, not ſo much in the order, in which they occurred, or I ſet them down, as in that of the relation, they appear, upon a comparative analyſis, to bear to this; which I fix upon, not ſo much as the beſt in my judgement, but as the moſt remarkable; that, with which moſt analyſers have taken moſt pains, and moſt phyſicians preſcribe; that which is generally tranſported, and that which may therefore ſerve as a kind of meridian or ſtandard, to which all others of this claſs may be compared.

II. *Of*

II. *Of the* GROISBEECK *ſpring at* SPA.

In pure Reſpect and profound Veneration
To a philoſophic Head,
To a moſt noble and benevolent Heart,
And
To a moſt excellent Friend,
Humbly Inſcribed
To
The Honorable
The LADY ARABELLA DENNY.

§ 138. THE GROISBEECK, which in the general view of theſe ſprings ſtands the third, § 44. from affinity ſeems to demand the ſecond place in this order. Being but a ſmall, ſhallow ſpring, it is not ſo apt to be found varied by the air, as thoſe that have a larger baſon to the like ſource. It is pellucid and colorleſs; ſeems to indicate ſomewhat of a ferrugineous or of the decompoſing pyrite ſmell; but that may probably ariſe from the ſoil round it, impregnating the air with ſuch exhalations: for, at a diſtance, the water has no perceptible particular ſmell. It's taſte is vitriolic, with a remarkable ſenſe of ſubacidity and ſtypticity.

§ 139. It does not ſparkle upon being taken up in a glaſs; but, in a ſhort time after, it lines the glaſs with ſmall, bright air-bubbles, and upon ſtanding, and other like means, ſuffers the ſame changes and decompoſition with the Pouhon, from § 89 to 93; preciſely, in appearance and time. So that it requires the ſame caution, in point of time and ſeaſons of drinking, with the preceding. It gives the like

muſical eructations, in ſoft, warm weather, as the Pouhon; for the like reaſon, § 89.

§ 140. The temperature of the water, taken in the ſame ſeaſons and ſtate of the Atmoſphere with the Pouhon, § 94; from 67 to 84; by the ſame thermometer, was from 51 to 53. It's coldneſs is always ſuch, as moiſtens the outſide of the glaſs, in which it is contained, more powerfully, than the Pouhon does at any time in the ſame temperature of the atmoſphere.

§ 141. The phial, in which the Pouhon was weighed, § 95; filled with this, weighed ounces 6. 2. 2. $6\frac{1}{2}$ That is, half a grane more; which aroſe from it's greater coldneſs; for, when they are taken of the ſame temperature, this is the lighter, by nearly as much as it now appears the heavier. But, by the ſame means, ſpoiled of it's volatile parts, 2. 3. 4; it comes to the ſame weight with that, or ſeems to excede it; the quantity of volatile parts being rather more in this, than in that.

§ 142. 1. With the ſirup of violets, in the ſame proportion, as in the Pouhon, § 97. 1; it ſtrikes inſtantly a pale crimſon; as ſuddenly changes to a purple, with more of the roſe, than the violet; in about two minutes, it puts on a pale ſky blew; thence, it turns to a ſea green; then, gradually to a deeper, a bright green; every change beginning at the ſurface; and thence, by degrees, extending all over the mixture.

2. The water, lying the ſame time in a glaſs expoſed to the open air, § 139; puts on the ſame appearances with the Pouhon, § 92. 1. except, a paler pellicule; with this, the ſirup of violets, ſhews a purple, and is longer in changing from that to blew and the different ſhades of green, than the Pouhon or any other of the waters; which, in mine apprehenſion, is to be attributed to a ſtronger impregnation with the mineral acid and leſs of the fixed parts than in the Pouhon.

§ 143.

§ 143. It affords the like appearances with the Pouhon, § 98. 99, with the juice of blew-bottle and blew paper; the tinge more upon the red, and the inclining to green and the abatement of color ſlower in this than in that; which muſt precede from a greater abundance of the mineral acid.

§ 144. With the infuſion of galls [a], it ſtruck nearly the ſame purple dye, as the Pouhon, § 100. 1; the tinge more quick and more upon the crimſon. It does not become ſo opac, as the Pouhon; nor is it ſo apt to coagulate.—This ariſes, probably, from the Groiſbeeck's having leſs earthy parts, or a leſs volatile acid.

§ 145. A glaſs of it, expoſed to the air, in the ſame time and temperature with the Pouhon, loſes it's tinging quality with galls many hours ſooner; which argues a ſlighter impregnation with iron.

§ 146. Spoiled of it's air, &c. by agitation onely, it ſtrikes it's peculiar dye the more ſuddenly with galls. And,

§ 147. After it has by ſtanding, by agitation or fire, loſſed it's pellucidity, ſmartneſs and vitriolic taſte, as well as dying quality, with galls; all may be, in appearance, reſtored by a ſmall quantity of the common vitriolic acid; as the Pouhon is, § 100. 5. All which are to be accounted for, in this, as in that, § 100. 101. The truth of which is alſo further evinced by the following;

§ 148. Filings of iron, thrown into this, produced all the ſame appearances and effects, as in the Pouhon, § 102. 103. 104.

§ 149. At the end of five days, it tinged the ſame dye with the infuſion of Galls, as in the Pouhon, § 105. 1; but, did not coagulate; as this water is leſs terrene; § 143. And in about nine days, this impregnation alſo loſſed it's purple tinging faculty; by the eſcape of the acid ſolvent.

[a] Where different proportions are not expreſsly mentioned, thoſe uſed with the Pouhon are always to be underſtood in the ſubſequent trials of all the waters of this claſs.

§ 150. This impregnation, § 148, ſtands longer fine after filtration, and retains it's tinging faculty with galls, much longer than the Pouhon, § 105. 2. Upon heating and evaporation, it yielded much the ſame appearances and products, as 3, 4. Which give it an equal titule with the Pouhon to the appellation of Acidula, as well as Chalybeata; a ſubacid, ferrugineous water.

§ 151. The ſpirit of ſalt ammoniac, with quick lime, produces preciſely the ſame appearances in this, as in the Pouhon, § 106; except the precipitation's being ſmaller in quantity; which verifies the obſervation upon § 143.

§ 152. The ſpirit of the ſalt ammoniac, with a fixed alcali, produced alſo the ſame effects in this, as in the Pouhon, § 107; the precipitate ſmaller and paler; the appearance of ebullition ſeeming ſomewhat greater: For the preceding reaſons.

§ 153. The alcaline ley cauſed the like changes, and in the like manner, and the ſame alteration of the ſalt, as in the Pouhon, § 108; the precipitate not quite ſo great, nor ſo much colored; the pellicule paler. In further proof of the preceding obſervations.

§ 154. All the acids cauſe nearly the like appearances and effects with this and the Pouhon, § 110; and for the like reaſons with thoſe aſſigned, § 111. 112. 1. 2.

§ 155. The ſolution of ſope is more expeditiouſly, effectually and in a greater quantity decompoſed, than in the Pouhon, § 113. 1; but the further it is, by any means, ſpoiled of it's valatile acid, the more uniformly the ſope unites with it; and for the like reaſons, § 113. 2.

§ 156. Yet, it does not curdle, nor any way ſenbly alter milk; ſo that they may with ſafety, and in many caſes with propriety, be taken together; for the reaſons ſet forth, § 114.

§ 157.

§ 157. The effects of the ſolution of corroſive ſublimate upon this water correſponded with that of the Pouhon, § 116; with ſomewhat more appearance of milkineſs; but ſtill leſs appearance of the terrene precipitation. Whence, the ſame concluſion, nearly, as in § 117, may be drawn.

§ 158. The ſolution of mercury produces, in all reſpects, the ſame appearances and effects, as in the Pouhon, § 118. 1. 2; and for the ſame cauſe; § 119.

§ 159. The ſolution of lead cauſes the like white precipitation, pellicule and other appearances in this, as in that of the Pouhon, § 120; to be accounted for upon the ſame principles; § 121.

§ 160. The ſolution of ſilver produced the like commotion, precipitation and other appearances and effects in this, as in the Pouhon, § 122; the precitate perhaps a ſhade darker. The cauſe of the decompoſitions are the ſame as ſet forth in § 123.

§ 161. Deſtilled as the Pouhon, § 124, it exhibited the ſame appearances and products; with theſe differences, that the pellicule was leſs colored, and it did not ſo ſoon grow turbid, nor ſo much.

§ 162. The deſtilled liquor, like that of the Pouhon, did not very ſenſibly differ from common water deſtilled; but, this produced effects analogous to thoſe of the liquor deſtilled from that, rather ſtronger, § 124; 1. with ſirup of violets; 2. with blew paper; 3. with the ſolution of ſope; 4. with a volatile alcali; 5. with the ſolution of ſilver; 6. with the ſolution of lead; 7. upon blew paper ſet in the junctures of the deſtilling veſſels; and 8. in the remander's ſtriking no ſhade of red or purple with ſirup of violets. All ariſing from the ſame cauſe in the one, as in the other, § 125; a moſt ſubtil, volatile, acid ſpirit, the proper ſolvent of the iron it contains; which iron gives none evidence of any degree of volatility, contrary to the received opinion; § 126.

§ 163.

§ 163. This has already appeared from various experiments; but, is ſtill more planely evinced by the martial matter's precipitating in the form of ochrous clouds, upon giving that water, like that of the Pouhon, § 127, a boiling heat. This being, by filtration, ſeparated, waſhed with deſtilled water and dried, gives us the quantity of iron the water contains, which is ſo far from volatile, that it is thus collected, and being dried, appears to be about ſeven granes in twenty pints. This ſtands the ſame teſts of that of the preceding, § 127. 1. 2 3. 4. If this quantity be evaporated to a dryneſs, without ſeparating the parts, it gives a bright brown powder, near the color of Spaniſh ſnuff, beſet with a few, minute, ſhining ſpangles.

§ 164. Twenty pints of the Grioſbeeck water, ſpoiled of it's iron, § 162; being, in the ſame apparatus and manner, evaporated to a dryneſs, as the Pouhon, § 129; exhibits the ſame appearances and products, to the quantity of about eleven granes.

§ 165. This waſhed, as that of the Pouhon, § 130. gave a liquor nearly analogous in color; in which, it appeared the firſt or deepeſt, upon compariſon; in taſte and effects, quite agreeing with that. And,

§ 166. Being evaporated to a dryneſs, it gave a ſalt exactly correſponding with that, § 131. 132. 133; to the quantity of four granes. This, in the ſame time, expoſed to the ſame air, increaſed in weight, one grane and an half, from the ſame cauſe.

§ 167. In the coffin, through which the preceding waſhings or ſolutions was paſſed, remaned a terrene maſs, weighing about ſeven granes; which, like the earth of the Pouhon, § 134, 135; proved to conſiſt of ſelenite and calcarious earth, in proportions nearly equal, the later the greater.

§ 168. This then, appears to be a water, impregnated

nated upon the ſame principles, and with the like ingredients, with the Pouhon; but, in different proportions; which the reader may eaſily determine upon comparing the preceding experiments, upon each water to thoſe on the other. By all which, in general, it appears, that the Groiſbeeck is endued with more acid and leſs terrene parts, than the Pouhon.

III. *Of*

III. *Of the* SAUVENIER *ſpring at* SPA.

With great Reſpect and Gratitude
Addreſſed
To
SIR WILLIAM FOWNES BARONET.

§ 169. AS in ſituation, ſo in affinity, the SAUVENIER or SAUVENIERE, which, in the general deſcription, ſtands, § 43. No. 2. demands the third rank from the Pouhon, in this order, and the next after the Groiſbeeck. As the baſon of this ſpring is but ſmall, in reſpect to it's ſource, it is not ſo apt to ſpoil, as thoſe, whoſe baſons hold more. In perfection, in which ſtate, we are to ſuppoſe all that are or ſhall be ſpoken of, when the contrary is not indicated; it is bright and colorleſs; but, depoſites an orange colored ochre in it's courſe. In taſte, it approaches neareſt the Groiſbeeck; than which, it ſeems ſomewhat leſs ſubacid and auſtere. And has no perceptible ſmell, examined at a diſtance from it's ſource; whereas near or about it, more or leſs of the pyritous ſmell is generally perceptible. In it's ſpringing it ſometimes gives muſical ſounds, § 90.

§ 170. 1. It does not ſparkle upon being taken up in a glaſs; unleſs poured from one veſſel into another; then, it ſparkles briſkly; but otherwiſe, it onely lines the inſide of the veſſel with ſmall bright air-bubbles. Upon theſe ſeparating, it throws up a diverſicolored pellicule, not quite ſo deep as the Pouhon, but deeper than the Groiſbeeck. 2. In ſtanding an equal time in the open air, it appears as milky nearly, as the Pouhon; does not let the like precipitate ſubſide. 3. By ſtanding longer, or by agitation or fire, it ſuffers a ſimilar decompoſition, in all things; but

but lets a lighter colored earth, than either of the preceding, precipitate.

§ 171. The temperature, by the thermometer, at the ſame time with the preceding, § 94, 140; was to the atmoſphere, as 52, 53, to 67, 84; leſs cold, by a degree, than the Groiſbeeck.

§ 172. The phial, in which the others were weighed, § 95, 141, filled with this, of 52 degrees of temperature, weighed ounces 6. 2. 2. 6, and about a quarter; but, ſpoiled like the others of it's volatile parts, it comes to much the ſame weight; about ounces 6. 2. 2. 8.

§ 173. 1. With the ſirup of violets, as in § 97. 1, § 142. 1; it ſhews, firſt a crimſon; whence, in about the ſame time, it changes, to a roſe purple, violet, blew, ſea green and green: all the changes beginning at the ſurface, and thence gradually extending all over the mixture.

2. The water lying the ſame time in the ſame air, with § 92. 1, § 139; diſcharged air-bubbles and threw up a pellicule like theſe; but paler and lighter. Then, with the ſirup of violets, ſhewed firſt a purple, then a blew, and afterwards a green, much ſlower than the Pouhon; than which, it appears to have more of the acid; but ſooner, than Groiſbeeck, of which, it falls ſhort, in this impregnation.

§ 174. With the juice of the corn blew-bottle, and the blew paper, it's effects correſpond with thoſe of the Groiſbeeck, § 143.

§ 175. 1. With the infuſion of galls, it produces nearly the like effect, as in the Groiſbeeck, § 144. Upon ſtanding, it appears of a deep, rich color, between a crimſon and a purple.

2. The altered water, § 170. 2. § 173. 2, as in § 145; It gives but a kind of Madeira wine color, with the infuſion upon mixture; and upon ſtanding longer, loſſes this tinging quality much ſooner than the Pouhon.

§ 176. If ſpoiled of it's air, and partly of it's ſpirit,

rit, onely by agitation, § 146; it ſtrikes it's dye, like the reſt, more readily.

§ 177. And being ſpoiled of it's pellucidity, ſmartneſs, vitriolic taſte, purple tinging quality, by the ſame means with the preceding, § 100. 5. § 147. they may, in the ſame manner and by the ſame means, be reſtored, with the vitriolic acid.

§ 178. The filings of iron produced all the ſame appearances and effects in this, as in the Pouhon, § 103. 104; and in the Groiſbeeck, § 148. With thoſe, the purple tinging quality was improved.

§ 179. At the end of five days, this ſtruck a deeper dye, than § 105. 1, or § 149, bordering upon a claret color; and does not, like the former, coagulate; for the like reaſons with the later, but ſtronger. Yet this, like theſe, entirely loſes it's purple tinging quality, upon ſtanding eight or nine days, even on the filings of iron.—An argument of the great ſubtility of the ſolvent in each.

§ 180. This water diſſolves ſomewhat more of the iron, and ſtands longer fine, after filtration, and longer preſerves it's purple tinging quality, than the Pouhon, § 105. 2; But, upon heating and evaporating, it yields much the like appearances and products, as § 105. 3. 4, and § 150; the precipitate and the extract rather paler, than either. Theſe give this the ſame titule with the preceding to the appellation of Acidula and Chalybeata, a ſubacid, ferrugineous water.

§ 181. The ſpirit of ſalt ammoniac, with quick lime, produced nearly the ſame appearance and effects, as in § 106. 151.

§ 182. The ſpirit of ſalt ammoniac, with a fixed alcali, produced nearly the ſame appearance and effects, in § 107. § 152; the precipitate and pellicule lighter and paler.

§ 183. The alcaline ley produced ſimilar appearances and effects to thoſe, § 108. 153; ſlower and ſmaller,

ſmaller, than either, and the precipitate and pellicule ſtill lighter and paler.

§ 184. All the acids cauſe ſimilar appearances and effects with thoſe on the Pouhon, § 110, and thoſe on the Groiſbeeck, § 154; and for reaſons agreeable to thoſe aſſigned, § 111. 112. 1. 2.

§ 185. The ſolution of ſope is decompoſed, in much the ſame manner, in this as in § 113. 1, or § 155; rather more ſlightly, than in the later. But, upon being ſpoiled, as that, of it's acid; the ſope in proportion unites. For the reaſon aſſigned, § 113. 2.

§ 186. It agrees, in all reſpects, with milk, upon the ſame trials, and for the like reaſons, with thoſe ſet forth in § 114, 156.

§ 187. The ſolution of corroſive ſublimate produces none other effects in this, than in § 116. 157; except a further inclination to milkineſs, which ſhews, this contains ſomething more alcaline, than theſe, § 117, in the natural ſtate.

§ 188. The ſolution of mercury cauſed much the ſame appearances and effects, with thoſe of § 118. 1. 2. § 158; for the reaſons aſſigned, § 119.

§ 189. The effects of the ſolution of lead were much the ſame in this as in § 120. 159; but ſomewhat inferior to the later; and are explicable upon the ſame principles, as in § 121.

§ 190. The ſolution of ſilver produced nearly the like effects in this as in § 122. 160; rather to ſomewhat ſlighter and more pale in color. They appear, however, to be founded on the ſame reaſoning, § 123.

§ 191. In deſtillation, it gives the ſame appearances and products with § 124, 161; as far as human ſenſes can compare them. But, the pellicule was leſs colored, and the ſediment lighter and paler, in this than in either of the others.

§ 192. The deſtilled liquor to the ſenſes and by the experiments, § 124, 162, 1. 2. 3. 4. 5. 6. 7. as well as the remaning 8, appeared analogous, § 125; and contrary to the received opinion, § 126.

§ 193.

§ 193. The ochrous or martial earth is ſeparated from this, in the ſame manner as in § 127, 163. The proportions differ: The ſolid contents of this are the ſame in weight with thoſe of the Groiſbeeck; to wit, in twenty pints, eighteen granes, of a pale brown ochre color, with minute, bright, ſhining ſpangles of ſelenite.

§ 194. This being ſeparated into it's conſtituent parts, as in § 163, 164, 165, 166, 167, appeared to conſiſt of, 1. An ochrous earth, or precipitate of iron, about ſix granes and an half; ſtanding the teſts, § 127. 1. 2. 3. 4. 2. Of a ſalt of the ſame nature with that of § 131, 132, 133, to the quantity of about five granes; whoſe ſolution compared to the reſt in depth of color, is the fiveth; 3. Of earthy parts, about ſix granes and an half, partly, and moſtly calcarious, and partly ſelenite.

§ 195. This alſo appears to conſiſt of the like ingredients, compounded upon the ſame principles, with the Pouhon and Groiſbeeck; but, in proportions more different from the former, more correſpondent to the later.

IV. *Of*

IV. *Of the* WATROZ *ſpring at* SPA.

With due Gratitude eſteem and Friendſhip,
Inſcribed
To
CHARLES GARDENER, ESQ;

§ 196. THIS ſpring, being the loweſt in ſituation, with reſpect to the adjoining ſoil, and one of the ſloweſt ſprings, is more apt to contract foulneſs, by decompoſing, and depoſiting it's ochrous earth in it's baſon, as well as in the courſe of it's water. When it is by often emptying cleared of this, it's water is as brilliant and as briſk, as moſt of them, and not inferior in medicinal virtues to many, if to any, of them; though it has been moſt egregiouſly miſtaken. In the general view of the ſprings, this ſtands § 49. N° 7. Here, it ſeems to clame the next rank to the Sauveniere.

§ 197. In ordinary, as it now lyes much neglected, it is hardly ſo bright and pellucid, as any of the reſt. It is as colorleſs. In taſte, it is ferrugineous and auſtere, and after the fountane has been newly emptied and cleaned, it is ſmart and brilliant; but, not, as I have ſeen it, quite equal to it's neighbours. It has no perceptible ſmell; but the place about it ſmells always very ſtrong of decompoſing pyrites, or like heaps of ruſting iron, eſpecially in warm, moiſt weather; when it is rather more muſical, than the Pouhon; § 90.

§ 198. It does not ſparkle upon taking up in a glaſs; but, it lines the inſide and lower part of the glaſs with air-bubbles, upon ſtanding ſome minutes; though more thinly than the reſt. I judge, if it were more frequently drawn, it might, in ſenſible qualities,

anſwer the ſame teſts with the others. 2. Upon ſtanding in open air, it ſuffers preciſely the ſame changes, in the ſame length of time, with the Sauveniere; but, ſeems ſomewhat leſs milky. 3. By ſtanding longer, or by agitation or fire, it ſuffers a like decompoſition in all things; the terrene parts ſubſiding, onely higher colored and ſeeming rather more in quantity.

§ 199. It's temperature, at the ſame time with the Sauveniere, § 171, was to the atmoſphere, as 53, 54, to 67, 84; leſs cold by a degree. Though this probably would not be, if this were as frequently cleaned and drawn, as that.

§ 200. The phial, in which the others were weighed, § 94, § 141, 172; filled with this, of 53 degrees of temperature, weighed ounces 6. 2. 2. 6, and leſs than a quarter more. But, ſpoiled like them of it's volatile parts, the ſame volume comes nearly the ſame weight with theirs, ounces 6. 2. 2. 8.

§ 201. 1. With the ſirup of violets, as in § 97. 1. § 142. 1. § 173. 1; it ſtrikes firſt a roſe purple; whence, it changes inſtantly to a bright blew, and ſoon after, to the ſeveral ſhades of green, the deepeſt after the Pouhon. Which argues a ſtronger impregnation either with the iron or the abſorbents or alcalies.

2. The water ſpoiled, by lying the ſame time in the ſame air with § 92. 1. § 139, 173. 2; It ſhewed, firſt a purple, but in an inſtant afterwards, a blew, and then, very ſuddenly after, became a bright green all over, the next in order to the Pouhon; upon the ſame principles, above ſet forth.

§ 202. With the juice of the corn blew-bottle, and the blew paper, it's effects agree, more with the Pouhon alſo, § 98. 99.

§ 203. 1. With the infuſion of galls, it firſt ſtrikes, in about half a minute, a pale crimſon; then, turns to the ſame color and appearances with the Pouhon. § 100. 1. or rather nearer the Sauveniere, § 175. 1; for,

for, it does not coagulate; but ſeems more upon the violet.

§ 204. 2. The altered water, § 198. 2; at firſt, ſtrikes a deep Madeira color; and by ſtanding, high-thens to a roſe-purple; and keeps this tinging quality, nearly as long, as the Pouhon.

§ 205. If ſpoiled of it's air, and partly of it's ſpirit, onely by agitation, or the pump, as in § 100. 3: § 146, 176, it ſtrikes it's dye more readily, like the reſt.

§ 206. And, being ſpoiled of it's pellucidity, ſmartneſs, vitriolic taſte and purple tinging quality, by the like means with the preceding, § 100. 4. 5, § 147, 177; all may be, in a great meaſure, and by the like means, the vitriolic acid, reſtored: which ſhews the affinity, this artificial acid bears to the natural or univerſal, in the water.

§ 207. With the filings of iron, the ſame appearances and effects were produced with this, as in § 103, 104, 148, and 178; the evident marks of ſolution, and further proof, by the improvement of color, which was firſt crimſon and then purple, and ſoon after coagulated and precipitated.

§ 208. At the end of nine days, this infuſion retained it's purple tinging quality, equal to the firſt or ſecond day.—Which indicates the acid in greater quantity or of a more fixed nature, than in the preceding.

§ 209. This water diſſolves about the ſame quantity of the iron, with the Pouhon. And upon heating and evaporating, yields much the like appearances and products, as § 105. 3. 4; all which conſpire to confirm this water's titule to the appellation of Acidula and Chalybeata, a ſubacid and ferrugineous water, equal to any of the reſt.

§ 210. The ſpirit of ſalt ammoniac, with quick lime, produced nearly the ſame appearances and effects, as in § 106, 151, 181; the precipitating earth

ſeeming ſomewhat higher colored, than the firſt or third.

§ 211. The ſpirit of ſalt ammoniac, with a fixed alcali, produced nearly the ſame appearances and effects, as in § 107, 152, 182; the precipitate and pellicule nearer the Pouhon.

§ 212. The alcaline ley produced the like changes, as in § 108, 153, 183; more near the firſt; but inferior in quantity and color of precipitation and pellicule; together with the like changes as with the volatile alcali.

§ 213. All the acids work the like changes and effects in this, as in § 110, 154, 184; and for the ſame reaſons, § 111, 112. 1. 2. but, not quite ſo briſkly, as the well is leſs frequented and drawn. If it were more ſo; there is reaſon to apprehend, that in this, they might appear equal.

§ 214. The ſolution of ſope is decompoſed, in much the ſame manner, rather inferior to § 113. 1. 155, 185. Which, I attribute to this well's being leſs frequently emptied. Being, like the others, further ſpoiled of it's air and acid, the ſope leſs or more intimately mixes with it; for the reaſons aſſigned, § 113. 2.

§ 215. It agrees perfectly, and in all reſpects, with milk, upon the ſame trials and the like reaſons, with thoſe of § 114, 156, 186.

§ 216. With the ſolution of corroſive ſublimate, it ſuffers no more ſenſible change, than the preceding, § 157, 187; an argument of it's containing no more of an alcaline ſalt predominant in this ſtate, than thoſe; though it ſeems ſomewhat more in this than in the Pouhon, § 116; § 117; from ſome greater appearance of precipitation.

§ 217. The ſolution of mercury produced effects analogous to thoſe in the Pouhon, § 118. 1. and to the others, § 158, 188; but, inferior in quantity and color of precipitation.

§ 218. The effects of the ſolution of lead in this

were

were analogous to thoſe in § 120, 159, 189; but inferior even to the later. And are explained upon the ſame principles, § 121.

§ 219. The ſolution of ſilver cauſes all the like appearances, ſlower and ſlighter in this, than in the Pouhon, § 122; quicker and greater than in § 160, 190; founded on the ſame principles and reaſoning; § 123.

§ 220. In deſtillation, it exhibited the ſame appearances and products with § 124, 161, 191; as far as ſenſes can diſcern; but, the ſparkling did not riſe quite ſo high; the pellicule and muddineſs rather nearer that of the Pouhon, than the others.

§ 221. The deſtilled liquor appeared to the ſenſes, as well as by the ſeveral experiments, § 124, 162, 192, 1. 2. 3. 4. 5. 6. 7, together with the remaning liquor, 8, to correſpond. But, of this, the Watroz ſeems the weakeſt, as containing leſs of the ſubtil acid than the reſt; though enough to contradict the received opinion.

§ 222. Evaporated to dryneſs, twenty pints of it yield much the like appearances and products with the Pouhon, rather higher colored; in the proportion of twenty granes.

§ 223. After it gets a boiling heat, the ochre ſeparates from the other terrene parts, as in the Pouhon, § 127; this, well waſhed with warm deſtilled water and dried, weighes near eight granes, and ſtands the ſame teſts with the preceding; 1. 2. 3. 4.

§ 224. This being ſeparated, and the remanes evaporated to a dryneſs, gave a mixed maſs, conſiſting of earth, ſome ſalt, with ſome oily matter to color it, in the proportion of twelve granes.

§ 225. Theſe parted by waſhing, as thoſe of the Pouhon, § 130; gave a liquor in color, compared to the reſt, the ſecond, in taſte and qualities, correſponding with that alſo; And,

§ 226. It gave, by evaporation, a ſalt in the proportion of ſix granes, exactly correſponding with that of the Pouhon, § 131, 132, 133. In the like time,

in the ſame air, increaſing in weight, three granes, from the like cauſe.

§ 227. The terrene non-metallic parts ſeparated by filtrating, being well waſhed and dried, weighed ſix granes; which, like the earth of the Pouhon, § 134, 135, or Groiſbeeck, § 167, or Sauveniere, § 194. are partly ſelenite and partly abſorbent earth, in much the ſame proportion, about two of the one, to three of the other.

§ 228. Hence, we may conclude this a water compoſed of the ſame ingredients, impregnated upon the ſame principles, and, though in different proportions, of courſe endued with ſimilar properties and medicinal virtues. Hence, they err, who deem it purgative. To avoid ſeeming repetitions, as may well be done, where ſo much plenty appears; without pointing out the minute diſtinctions, I ſhall onely ſay, that the neglected fountane of POUHON PIA, § 46. N°. 5. ſtands next in affinity to the Watroz.

V. *Of*

V. *Of the* GERONSTER *ſpring at* SPA.

With the utmoſt Reſpect and Affection

To

The Natural Philoſopher,

The Public-Spirited, Free Subject,

And

The moſt generous, beneficent Friend;

Addreſſed

To

JOHN HYDE ESQ;

§ 229. THIS ſpring, which in the general view of theſe waters, ſtands in § 45. N° 4. in this order, comes next to the Watroz. This water is not apt to foul it's baſon, nor lye covered in it with a pellicule, more than the Groiſbeeck or the Sauveniere; becauſe, their ſeveral baſons are better adapted to the ſtrength of their ſprings, than thoſe of the Pouhon, or the Watroz. It covers the baſon round at the high water mark, with a little line of pale ochre, of which, it alſo makes a depoſite in it's courſe.

§ 230. In aſpect, it is colorleſs and quite bright. With the ſmell, common about the other waters, which may, in themſelves, be looked upon as inodorous, this has ſomewhat of the fetid ſmell, which ſome aſcribe to rotten eggs, or rather more like the ſolution of liver of ſulphur precipitating with an acid, or, which is ſtill more familiar, the waſhings of a foul gun.

§ 231. This is in general more or leſs perceptible in the water; but moſt of all in moiſt, warm weather, or previous thereto. Hence, it has with ſome

obtained the name of Sulphureous; though with me, it is rather the product of putrefaction.

§ 232. When this ſmell is leſt perceptible in the water, to the outward parts of the organs of ſmelling; it is perceptible in, or after, paſſing the palate; and, in belchings, after it has reached the ſtomach. But, ſo ſmall is the quantity, that this is perhaps the onely method, I know, of diſcovering it. To this reputed, volatile ſulphureous quality, are the principal virtues of this water aſcribed. And the magiſtrates and phyſicians fearing it's extern conſumption might leſſen the company at Spa; have combined to propagate a notion of it's being ſpoiled by the ſhorteſt carriage from the ſpring. The grounds for which, ſhall in the ſequel, fall under conſideration.

§ 233. In taſte, it is moderately, not ungratefully, ſubacid and ſlightly ferrugineous. So that, were it not for it's ſmell, it might be ranked among the moſt agreeable.

§ 234. It does not ſparkle upon taking up, unleſs poured from one veſſel into another. But, upon ſtanding a few minutes in the open air, ſooner or later, according to the temperature of the atmoſphere, it covers the inſide of the glaſs with ſmall bright air bubbles; and condenſes enough of the humidity of the air, upon the outward ſide, to moiſten and obſcure the glaſs.

§ 235. In proportion, as theſe eſcape, it throws up a mother of pearl colored pellicule, and onely contracts a ſlight milky hue; when the Pouhon and the Groiſbeeck, let a terrene ſeparation palpably ſubſide, and the reſt appear turbid.

236. The temperature of this ſpring, at the different extremes, at § 94, 140, 171, 199, was to the atmoſphere, as 51, 52, to 67, 84. Hence, it appears the coldeſt of all the preceding, and in this, to be exceeded onely by the Tonnelet.

§ 237. The phial in which the others were weighed, § 95, 141, 172, 200; filled with this of 51 degrees of

of temperature, weighed ounces 6. 2. 2. $5\frac{1}{2}$. But when, like theſe, ſpoiled of it's volatile parts, the ſame volume weighs ounces 6. 2. 2. $7\frac{3}{4}$, near eight granes.

§ 238. 1. With the ſirup of violets, as in § 97. 1. § 142. 1. § 173. 1. § 201. 1. it ſtrikes, firſt, a roſe purple; whence it quickly changes to the brighteſt blew, and thence gradually, to ſuch a green, as the Sauveniere gives, and in the ſame time and manner, nearly.

2. The water ſpoiled, by lying the ſame time in the open air, with § 91. 1. § 189. 173. 2. § 198. 2; it ſhewed ſome faint appearance of purple; but, in an inſtant, turned to a pure blew, and next, in time and degree of color, green after Watroz.

§ 239. With the juice of the corn blew-bottle, as well as with blew paper, it correſponds with the effects of the Pouhon, § 98, 99, or rather more with the Watroz, § 202.

§ 240. 1. With the infuſion of galls, no perceptible change is produced for about half a minute; then, it changes to ſome degrees of obſcure purple, and gradually highthens to a roſe purple or crimſon bloom; or, as if ſome few drops of blew were mixed with the color of Burgundy wine. This approaches nearer to the Sauveniere, § 175. 1.

2. The altered water, § 235. with the ſame infuſion, produces nearly the ſame effects, as in Watroz, § 204. 2; rather paler.

241. If ſpoiled of it's air, by agitation or the air-pump onely, as in § 100, 3. § 145, 175, 2. 204. 2; it ſtrikes it's dye inſtantly, like the reſt.

§ 242. And, ſpoiled of it's pellucidity, taſte, ſmartneſs and purple-tinging quality, by the like means with the preceding, § 100. 4. 5, § 146, 177, 204; all may, in a great meaſure, and by the like means, a ſufficient quantity of the vitriolic acid, be reſtored: Which ſhews the affinity, this acid bears to that of each of the waters, and theſe of courſe to each other.

§ 243.

§ 243. With the filings of iron, the action of ſolution and all it's conſequences appeared in this water, as in § 103, 104, 105, 145, 207; nearly the ſame as in the laſt.

§ 244. At the end of five days, this infuſion retained it's purple tinging quality with galls, equal to the firſt or ſecond day; but loſſed it entirely before the nineth; which ſhews the paucity or volatility of the ſolvent.

§ 245. This hardly diſſolves as much of the iron as the Watroz, § 207; and, upon heating and evaporating, yields much the like appearances and products with § 105, 3, 4; inferior ſomewhat in quantity. Hence this, as well as the reſt, is to be allowed a rank among the Acidulae, as well as the Chalybeatae.

§ 246. The ſpirit of ſalt ammoniac, with quicklime, produced nearly the ſame appearances and effects, as in § 106, 151, 181, 210; moſt like the laſt but one.

§ 247. The ſpirit of ſalt ammoniac, with a fixed alcali, as in § 107, 152, 182, 211; produced nearly the like appearances and effects.

§ 248. The alcaline ley, as in § 108, 153, 183, 212, produced changes and effects analogous; leſs colored and more ſlight. The changes in the ſalt, as in the firſt.

§ 249. All the acids work the like changes and effects in this, as in § 110, 154, 184, 213; and for the like reaſons, as § 111, 112. 1. 2; but, inferior to all but the laſt.

§ 250. It decompoſes the ſolution of ſope, as in § 113. 1, § 155, 185, 214; in much the ſame proportion as the laſt. When it is by any means ſpoiled of it's air, it receives the ſope, more or leſs intimately in proportion, as it is diveſted of it's acid; for the reaſons aſſigned, § 113. 2.

§ 251. It makes no alteration in milk, more than thoſe

thoſe of § 114, 156, 186, 215; and for the like reaſons, § 114.

§ 252. With the ſolution of corroſive ſublimate, this ſuffered no more change of dropping than the others, § 116, 157, 187, 216; but, in about three hours, I obſerved it more milky, even to a pearl opacity. Which ſeems to indicate ſomewhat more of an alcaline matter, or a pure alcali; if not ſome of the inflammable principle, or the oily matter ſubtiliſed by putrefaction.

§ 253. The ſolution of mercury cauſed effects analogous to the others, § 118, 1, § 158, 188, but more to thoſe of § 217.

§ 254. The ſolution of lead anſwered to the effects produced in the others, § 120, 159, 189, 218; for reaſons given, § 121. But, the clouds and precipitate are not quite ſo bright a white, as in moſt of the others; which intimates a ſtronger impregnation with the inflammable principle; whence probably it's ſmell.

§ 255. The ſolution of ſilver correſponds in it's effects upon this with the others, § 122, 160, 190, 219; for the reaſons in § 123. ſeeming leſs upon the purple and ſomewhat more upon the aſh-color, than any of the reſt, for reaſons in the preceding §.

§ 256. It's appearances and products in deſtillation correſpond with thoſe of § 124, 161, 191, 220; as far as the ſenſes can diſcern. The ſparkling roſe not as high, as in the Pouhon; the ebullition was more inconſiderable; the bubbles ſmaller, and noiſe leſs. Nor did it appear quite ſo turbid.

§ 257. The deſtilled liquor, as well as the remaning, to the ſenſes, as well as upon the experiments, § 124, 162, 192, 221, 1. 2. 3. 4. 5. 6. 7. 8, appeared to correſpond with the reſt. Which proves it's titule to the appellation of Acidula, contrary to the general notion. It gave no ſenſible proof of any thing ſulphureous or phlogiſtic, more than the reſt; whence, we may conclude, it contains but little of that matter.

§ 258.

VI. *Of the* TONNELET *ſpring near* SPA.

With due Attention and Regard
To a Boſom, fraught
With every Social Virtue;
Inſcribed
To
BLAYNEY TOWNLEY, ESQ;

§ 265. THIS neglected fountane, which, in the general view of the medicated ſprings, ſtands in § 50. N° 8. naturally falls into this claſs, according to the order layed down. Though, in an other ſenſe, it merits the firſt rank of theſe, and perhaps, of all the known medicated ſprings of this denomination.

§ 266. This is one of the quickeſt and moſt ſprightly ſprings in the world, and the moſt colorleſs, clear and bright water. It neither does, nor can, foul it's baſon; whoſe bottom is therefore conſtantly clean and bright. And, if any foulneſs were thrown into it; the ſtrength of the ſpring and it's motion are ſuch, as muſt very readily reject and expell it. Yet, at the higheſt mark of the water, a little ſeam of bright orange colored ochre is ſometimes found; where the attraction of coheſion keeps ſome portion of the water always ſtagnant; but no pellicule can reſt on it's ſurface, from the quickneſs of it's motion and diſcharge.

§ 267. It has no perceptible ſmell; though from the ſoil around it, ſome pyritous exhalations are ſometimes perceptible, and muſical ſounds heared, § 90; eſpecially, in moiſt warm weather. Thoſe may and ſometimes do deceive the unwary.

§ 268.

§ 268. To the palate, it is moſt gratefully ſubacid, vinous, ſmart, and ſprightly, not unlike the briſkeſt Champagne wine, imprinting exceding little, if any vitriolic or ferrugineous taſte. Being drank, it generally ſits lightly and agreeably on the ſtomach; and, though exceſſive cold, it warms, cheers and invigorates. In a few minutes after drinking a large glaſs or two of the water, it cauſes eructations, as moſt waters of this claſs do; but, inſtead of their being offenſive, as moſt of theſe are, the laſt in particular, which cauſes nidorous belchings; this gives a ſmart, not diſagreeable ſenſation, upon making it's eſcape from the upper or left orifice of the ſtomach; is very quick in it's tranſition through the gullet to the throat; whence, if the mouth happens not to be open, it flies off by the noſe, making the ſame piquant impreſſion upon that organ, that is commonly made by the fumes of Champagne paſſing that way. Before my time, it was condemned formally by the phyſical faculty, and uſed onely by the more judicious boors; who make it their principal beverage, upon all occaſions. I am perſuaded, that had Paracelſas, Van Helmont, or any of our enthuſiaſtic chemical writers, that loved Champagne white wine, but ſeen Tonnelet water; they would have called it, Mineral Champagne. Compare this to the Pouhon, § 89; to the Groiſbeeck, § 138; to the Sauveniere, § 169; to the Watroz, § 196; to the Geronſter, § 229. and all the ſenſes muſt give this the preference.

§ 269. It does not ſparkle inſtantly upon taking up in a water glaſs; but while the eye is intent upon watching the changes, the glaſs becomes ſuddenly ſo obſcured or confounded to the ſight, that, at firſt view, it ſeems an extraordinary change in the water; whereas, upon examination, it is found to be onely a large, dewy moiſture, by the extreme coldneſs of the water, inſtantly condenſed on the outward ſurface of the glaſs; from which, it is not eaſily kept free for a long

long time. This being wiped off, as quickly as may be, the contained water will be obſerved to ſparkle, as briſkly as the Pouhon water, after bottling and tranſporting; for, in an inſtant, when the temperature of the air was at 66 degrees of Prins's thermometer, this water ſent from the bottom and center, to the ſurface and ſides of the glaſs, numberleſs minute, light, bright air-bubbles; the former eſcape, ſparkling; the later ſtick upon the ſides, and increaſing in volume, look like ſo many of the brighteſt oriental pearl, ſpangling the inſide of the glaſs. Though all the other waters give more or leſs of this appearance upon ſtanding; yet are they all almoſt as far inferior to this water in aſpect, as in taſte and other qualities.

§ 270. In proportion as theſe aerial, perhaps I might ſay, etherial, globules eſcape; the water amits of it's pellucidity, to ſome ſlight appearance of milkineſs, and throws a light mother of pearl colored pellicule to the ſurface. In this, it agrees with the Geronſter, § 235.

§ 271. The temperature of this ſpring, at the various extremes, in which the others were tried by the ſame thermometer, § 94, 140, 171, 199, 236; was to the atmoſphere, as 49, 50, to 66, 84. Hence, this appears the coldeſt of any of the ſprings of or about Spa. Yet, notwithſtanding,

§ 272. It is by much the lighteſt, though the coldeſt: For, the phial in which the others were weighed, § 94, 144, 172, 200, 237; filled with this, of the temperature of 50, weighed ounces 6. 2. 2. 5. But, when like theſe, ſpoiled of it's volatile parts by agitation, the ſame volume weighs ounces 6. 2. 2. 7. Whence, it appears, not onely in all reſpects leſs terrene, but more highly charged with a moſt ſubtil ſpirit and elaſtic air, than any of the reſt. This appears by comparing them by the §'s, numbered above; as well as by the following obſervation. If the phial be not immerged in the ſpring, it is impoſſible to fill it free from air-bubbles; and if it be not

ſtopped inſtantly, it will appear full of them as the glaſs, in which the water is viewed. But, thus filled and ſtopped, it may be well weighed without any appearance of an air-bubble. Yet, in ſtanding ſometime after in the open air, without opening, the ſame appearance is diſcovered, as if the bottle had been filled with hot water; a ſpace, not quite ſo conſiderable is found void of water; occupied by the ſubtil ſpirit and elaſtic air, which the warmer medium had ſeparated from this cold water, as the colder air condenſes the hot water and makes it occupy a leſs ſpace than before.

§ 273. It may be decompoſed by all the means, that ſpoil the Pouhon, § 92. 1. 2. 3. 4. 5; and the reſt, § 139, 170, 198; but, the phaenomena are moſt ſenſible in this. 1. It ſtands in the open air without a viſible change, longer than the Pouhon; but, it loſes it's ſpirit and abates of it's purple-tinging quality with galls, more in the ſame time. The reaſon of the change's not being viſible, is this being leſs terrene than that. 2. When agitated in a ſtopped bottle about half full, the air ruſhes out with a much greater exploſion; in the reſt, it agrees with the Pouhon; but, is not ſo turbid. 3. A bottle of this, whether completely or incompletely filled, and corked, if ſet in a warm place, will not onely either throw out the cork, or burſt the bottle, with a louder exploſion, than the Pouhon; but, if it be full will run over, like Champagne, or if the bottle be lying on it's ſide, the water will be thrown with the cork to ſeveral feet's diſtance from the bottle. After theſe like forcible protruſions of the cork, the water becomes ſpiritleſs and effete, in a great meaſure. 4. If ſet on the fire, or in a veſſel in hot water, or heated ſand, it is more quickly and ſenſibly affected, than the Pouhon or any of the other waters, and throws the air-bubbles ſome inches higher, in cloſe veſſels eſpecially; when thus decompoſed, it is not ſo high colored, as the Pouhon. 5. Placed under the receiver of an air pump, upon the exhauſting it, nearly the like ap-

pearances, as by fire, are produced; more quickly and ſmartly in this, than in the Pouhon. Whence, greater cautions are to be uſed for procuring this water in the fulleſt perfection. Yet, it bears bottling and tranſportation, in very cold weather, as well as any of the reſt. In the bottle, ſoon after it is filled and cloſe corked, ſome more empty ſpace than ordinary appears. This is not any loſs of ſubſtance, as ſome may imagine: It is onely ſome of the elaſtic air, that begins to eſcape from the water in a warmer medium; this is very apt to burſt the bottle. Therefore, it is beſt to let it out and fill the bottle with more water before it be cimented or pitched and tied over for tranſportation.

§ 274. 1. With the ſirup of violets, as in § 97. 1. § 142. 1. § 173. 1. § 201. 1. § 238. 1; it ſhews firſt a pale crimſon, and inſtantly after, a bright roſe purple; then, a violet color. In about two minutes, all tints of red vaniſh and leave the mixture of a bright, ſky blew. Soon after this appears at the highth, it begins, where all the changes are firſt wrought, to turn to a ſea green, at the ſurface; thence, it extends and improves all over by degrees, to a very beautiful, bright green. If when the green has extended to about half an inch below the ſurface, it be mixed; that color will predominate. But, if left unmoved, after the water be firſt poured on the ſirup, it will appear half green, half blew, the next day.

2. The water lying, the ſame time, expoſed to the open air, of the ſame temperature with the reſt, § 92. § 97. 2. § 142. 2. 173. 2. § 201. 2. § 238. 2; Or even by agitation, or the air pump, ſpoiled of all it's elaſtic air and ſpirit, ſtill ſhews ſome ſtrong appearances of purple, with this ſirup; but, in leſs than three minutes after, becomes a ſea green, and in leſs than five, a thorough green all over.

§ 275. From theſe experiments, § 273. 1. 2. 3. 4. 5. It appears, that this water is, the moſt ſtrongly of any, charged

charged with the ſubtil, volatile ſpirit, on which the chief energy of all waters of this claſs depends. When I firſt ſaw the crimſon hue, this water ſtrikes with the ſirup of violets, § 274. 1. 2; which beyond eſcaping the obſervation of all preceding analyſers; is againſt the general remarks and opinions, which goe no further than the laſt, the green color, and moſtly deny the cauſe, the ſubtil acid; I beat about for ſome accidental motive for ſo unexpected a change. Had I been contented with firſt appearances, I might have layed hold on the firſt, that offered, and probably have ſubſcribed to former notions: My firſt experiments were made at this fountane, at the dawning of a lovely morning, in the beginning of Auguſt 1752, with my glaſſes on the top of the ſtone, that covers the ſpring and my face to the eaſt; where the clouds appeared of all the ſhades of crimſon, purple and ſcarlet. It firſt ſtruck me, that theſe colors, reflected to the glaſs, had deceived me. Till I got my ſervant to hold an Umbrella over me and ſhade off the colored light, I aſcribed this change in the water and ſirup to the clouds. I then ſaw my miſtake, confirmed it by repetitions of the experiment, in fairer light, and apprehending, that I have diſcovered the true cauſe, I here ſubmit it to the judgement of the diſcerning. Some ſhades of theſe colors are viſible in all the waters of this claſs; but, none of the preceding ſhews ſo much of the crimſon, as the Tonnelet.

§ 276. With the juice of the corn blew-bottle, as well as with the tournſol-dyed paper, effects were produced correſponding with theſe and thoſe on the other waters, § 98, 99, 143, 174, 202, 239; with ſtill more evidence of the acid, the crimſon or roſe purple, and more ſlowly changing to the green. Hence, I muſt think this water has the cleareſt clame to the appellation of Acidula, as we ſhall demonſtrate it intituled to that of Chalybeata.

§ 277. 1. With the infuſion of galls, as in § 100. 1. § 144. 175. 1. § 203. 1. § 240. 1; it mixes with-

out change; but, in leſs than a minute, it ſtrikes a pale crimſon; which becomes quickly deeper, and by and by, puts on the roſe purple, or inclines to the color of hermitage wine, or a mixture of crimſon and blew of extreme beauty, and long permanence, without coagulation or other change.

2. But, in the water altered by agitation, in as little time as it takes to ſtrike the firſt dye, in the unaltered, it comes to the deepeſt tinge. Or, upon ſtanding, the ſame time with the others, § 100. 2. § 144. 175. 2. § 204. 2. § 240. 2; it firſt and inſtantly tinges a Madeira wine color, and ſoon after, highthens to a roſe purple, or a mixture of crimſon and blew. This, as well as all the reſt, produces ſimilar effects with all other vegetable aſtringents. And theſe are one of the proofs of their being Chalybeata, impregnated with ſteel or iron.

§ 278. After it has been ſpoiled of it's elaſtic air and ſubtil ſpirit, and therewith loſſed it's pellucidity, taſte, ſmartneſs, and purple-tinging quality, by the like means with the reſt, § 100. 5. § 147, 177, 205, 241; all may, in the like meaſure and manner, be reſtored, by the addition of a ſmall portion of the vitriolic acid. A clear proof of the affinity, 1. of this acid to that of this and each other of the waters, and 2. of theſe, of courſe, to one another.

§ 279. With the filings of iron, the action of ſolution and all the other effects, ſeen in § 103, 104, 105, 148, 178, 207, 243, are produced, in a more evident and ſtrong manner, than in any of theſe.

§ 280. This diſſolved more, by two granes, of the iron, than any of the preceding. And retained it's purple tinging quality with galls, at the end of nine days, as well as at the firſt or ſecond day; whereas all the preceding, except the Watroz, loſſed theirs, by the fiveth day of their ſtanding; which, in a great meaſure, may be owing to the greater ſtrength of the impregnation, as well as to this water's being freer from terreſtreity, than the others; which is alſo the

reaſon,

reaſon, why the infuſion of galls cauſes not ſo great a coagulation in this ſolution, as in that in the Pouhon.

§ 281. As the impregnation of this infuſion was the ſtrongeſt; ſo, upon heating and evaporating, it proportionably yielded ſimilar appearances and products with § 105. 3. 4; ſuperior in quantity, by two granes. Who then, will deny this, the titule of Acidula, more than of Chalybeata?

§ 282. The ſpirit of ſalt ammoniac, with quick lime, as in § 106, 151, 181, 210, 246; produced analogous effects; but, it was leſs milky and turbid and more yellow, and the precipitate more upon the orange color; an argument of leſs earth and more iron in proportion.

§ 283. The ſpirit of ſalt ammoniac, with a fixed alcali, as in § 107, 152, 182, 211, 247; produced effects ſimilar in all reſpects; but, the ebullition rather more evident, and the pellicule more ſlight and pale.

§ 284. The alcaline ley, as in § 108, 153, 183, 212, 248; which, in the firſt, cauſed an evident milkineſs at the ſecond, and almoſt an opacity at the tenth drop; here ſhewed no change to the laſt; and then, but ſlight, milky clouds at bottom; and the like pellicule, but paler and ſlighter. This cauſed no more perceptible ebullition or commotion, than the reſt, and for the ſame reaſons. But made the ſame alterations in the alcaline ſalt, as 108. Does not this bear ſome analogy to STAHL's ſolution of iron in a fixed alcali; made by inſtilling a ſolution of this metal into a ſtrong alcaline ley, with which, it mixes by agitation, without any ſenſible commotion or precipitation? Does not this account for an acid and an alcali found in one and the ſame water, which ſome phyſico-chemiſts judge impoſſible, and therefore deride the name of Acidulae given to ſuch waters as yield a fixed alcali upon evaporation?

§ 285. All the acids work the like changes and effects in this, as in § 110, 154, 184, 213, 249; and

for the ſame reaſons, § 111. 112. 1. 2; but, in a much ſuperior degree; which ſhews it is the propulſion of the volatile acid, upon the addition of the more groſs, that raiſes the contraſt or ebullition: The proof of which is ſeen upon obſerving, 1. that the leſs of this volatile acid, any of theſe waters contains, the leſs ebullition or commotion is raiſed, upon the addition of the artificial acids; and 2. on the contrary, the more it contains of it, the greater the contraſt appears; as in this. Moreover, 3. the more this or any other of theſe waters is ſpoiled of it's acid, the leſs commotion will ariſe upon the addition of the groſſeſt and ſtrongeſt. And, 4. if this natural acid be totally diſſipated, as it is by fire; then no artificial acid, in the ſame proportion, is able to ſtir up any degree of the commotion it before occaſioned. Which to me ſeems to place this matter in a clear and indiſputable light, unattempted before.

§ 286. This water decompoſes the ſolution of ſope, as the reſt do, § 113. 1. § 155, 185, 214, 250; but, in a greater proportion than any, and neareſt the Pouhon. But, in proportion as it is by any means deprived of it's air and acid ſpirit, which always go together; it receives the ſope more or leſs intimately; for reaſons already aſſigned, § 113. 2.

§ 287. Yet, however evident an acid appears in this water, ſuch is the nature of that moſt volatile, ſubtil fluid, that it mixes as ſmoothly with milk, cold or hot, as any of the reſt, § 114, 156, 186, 215, 251, or even as common ſpring water; as explaned, § 114.

§ 288. With the ſolution of corroſive ſublimate, this ſuffered not ſo much change, as any of the reſt, § 116, 157, 187, 216, 252; except in ebullition, in which it exceded all; from the gravity of the ſolvent and ſolved in that ſolution: For, the water ſpoiled of it's air by agitation, ſuffers no change upon the inſtilling the ſolution.

§ 289. The ſolution of mercury, in the acid of nitre, cauſed

cauſed effects analogous to the reſt, § 118. 1. § 158, 188, 217, 253; but, the precipitation later and ſmaller.

§ 290. The ſolution of lead produced ſimilar appearances and effects in this, as in § 120, 159, 189, 218, 254; and for the reaſons given, § 121; but, in a lower degree, the precipitate the lighteſt and whiteſt of any; for reaſons to be hereafter ſeen; § 296, &c.

§ 291. The ſolution of ſilver alſo correſponds in effects in this, with thoſe in the others, § 122, 160, 190, 219; for the reaſons aſſigned, § 123; but, like the preceding, in an inferior degree in all, but the ebullition; the precipitate lighter in color and quantity, though neareſt that of the Pouhon, or between this and that of the Watroz.

§ 292. The appearances and products of this water, in deſtillation, as far as the ſenſes can diſcern, correſpond with thoſe of § 124, 161, 191, 220, 256; but, it was ſooner, or with leſs heat, affected; was more quick in it's ſparkling; the ebullition was more ſmart, ſtrong and noiſy, and threw up the globules higher and longer, than the Pouhon or any of the reſt; from it's abounding moſt with the ſubtil, volatile acid and elaſtic air.

§ 293. The deſtilled liquor, to the ſenſes, as well. as upon experiments, § 124, 162, 192, 221, 1. 2. 3. 4. 5. 6. 7. 8. appeared to correſpond with that of the reſt. But, this appeared the ſtrongeſt upon each trial. Who can diſpute it's titule to the appellation of Acidula?

§ 294. The liquor remaning after deſtillation appears almoſt, but not entirely, ſpoiled of it's ſubtil, acid ſolvent. In the operation, like the others, it threw up a diverſicolored pellicule, coated the glaſs, at the verge of the liquor, as on the verge of that in the fountane, with a little ſeam of bright ochre, and grew very turbid all over. When cold and viewed in a glaſs, it appeared of a muddy rediſh color,

which it borrowed from minute particles of light, red ochre ſuſpended aflote in it. This liquor differed from the others; 1. it did not yet ſo completely loſe it's acid ſolvent; for, it tinged firſt a Madeira color and ſoon after, a crimſon, upon the addition of the infuſion of galls. 2. This I expected from the taſte; for, it had onely loſſed it's vinous ſmartneſs, but had ſtill retained, and rather more ſenſibly imprinted, the vitriolic or ferrugineous taſte. In this, it ſomewhat reſembled vapid French white wine. 3. However, much of both the tinge and taſte depended upon the very ſubtil ſtate of diviſion, to which the precipitating ochre was now reduced; for, this being ſeparated by filtration, it loſſed it's color, abated of it's taſte and tinged but a very pale Madeira color with the galls; whereas before, it gave a crimſon, and upon ſtanding the ſame time with this, acquired ſome tint of purple. 4. It ſhewed a purple and a blew, before it gave a pale green, with the ſirup of violets. Theſe muſt have aroſe from a ſtronger attraction between the ſolvent and the ſolved, and a greater ſimplicity in the compoſition of the later, than in that of thoſe parts of any of the preceding.

§ 295. Twenty pints of this water, evaporated ſlowly to a dryneſs, give of a mixed matter, almoſt of a bole color, ſpangled with ſmall, ſhining, bright ſpiculae of ſelenite, twenty granes; that is, one grane of ſolid matter to the pint.

§ 296. To ſeparate theſe, ſolid, fixed parts, in this, as well as the other waters, it is beſt to continue it over the fire, till it ceaſes tinging with galls; then all the iron is in a ſtate of precipitation, and may be ſeparated by filtration, as in § 127, 163, 193, 223, 259. The coffin, through which twenty pints of this water, thus decompoſed, is paſſed, being well dried, is found increaſed in weight by ten granes. Hence, I conclude, that the martial earth makes one half of the ſolids, that impregnate this water; and that, as each pint contains one grane of ſolid matter, half of which

which is iron; each pint muſt of courſe contain half a grane of iron: For, this magiſtery ſtands all the teſts of § 127. 1. 2. 3. 4.

§ 297. The liquor, from whence the martial earth is thus ſeparated, is colorleſs and inſipid; and, being ſet to evaporate, yields the like appearances with the reſt, § 129, 164, 194, 224, 260, and the ſame product, when complete, to the amount of ten granes.

§ 298. This maſs waſhed, as in § 130, gave the paleſt colored liquor, with all the other properties of the preceding, § 130, 165, 194, 225, 261. It was the leſt colored, from this being the quickeſt ſpring. And,

§ 299. Evaporated to a dryneſs, before it was completed, it appeared colored, from the oily matter; and being dried, gave a ſalt, colored with this matter, without any appearance of a ſaline pellicule in the evaporation. This weighed five granes. And expoſed to the open air, for thirty ſix hours, abſorbed humidity enough to increaſe it's weight one grane and an half. Which gives ſome intimation of the nature of the ſalt, by pointing out the portion of it, that may be purely alcaline: for, this may be reckoned to abſorb it's own weight of moiſture to diſſolve it. Hence, I preſume this ſalt not quite ſo purely alcaline, as that of the Geronſter, § 262.

§ 300. The terrene, non-metallic parts, which, ſeparated by the laſt filtration, well waſhed and dried, weigh five granes; upon the ſame trial, as in § 134, 135, 167, 194, 227, 263; appear to be partly and moſtly abſorbent earth, to about three fiveths; the reſt, ſelenite.

§ 301. Hence, it is no preſumption to conclude, that this alſo is a water impregnated upon the ſame principles; with the ſame ingredients, though in proportions different. It's properties and virtues muſt therefore be the ſame; with ſome difference ariſing onely from the diſparity of proportions.

VII. *Of*

VII. *Of the Fountane of* SART, *or* NIVESET, *near* SPA.

With all Reſpect and Humility,
Inſcribed
To
The Honorable Mrs. ELLIS.

§ 302. THIS fountane is by nature placed in the order, I now give it, next to the Tonnelet, § 51. N° 9. Though the baſon of the ſpring is much too large, and the motion of the water is not viſible, through the body of water, that covers the ſource; yet, it is obſervable, that it does not foul it's bottom and onely depoſites a little ſeam of ochre, like it's next neighbour, at the verge of the water; where, from the attraction of coheſion, there muſt be ſome ſtagnation. In it's courſe, it depoſites plenty of a ſimilar ſediment. Confer with § 265, &c.

§ 303. In aſpect, this ſpring correſponds exactly with the Tonnelet; it is equally colorleſs and as perfectly limpid. It is by itſelf alike inodorous; yet, about it, the pyritous ſmell is often found, much as about the reſt of the ſame kind; which, without this caution, might be attributed to the water. Confer § 266. 267.

§ 304. In taſte, it alſo bears great affinity to the Tonnelet; but is leſs vinous, ſmart and briſk; more acid, auſtere and ſtyptic. And does not ſit quite ſo agreeably upon the ſtomach. Though it is drank as common beverage by all the poor people of the neighbourhood, to whom, it is nearer than the Tonnelet; not having diſcovered the difference: Such as have drank of this later, can not ſo well reliſh any other. Confer § 266.

§ 305.

§ 305. Upon taking up in a glaſs, it exhibits much the ſame appearances, and nearly as readily; § 269.

§ 306. In proportion as it's elaſtic air and volatile ſpirit exhales, it amits of it's pellucidity and throws up a pellicule, bearing near analogy to thoſe of § 270.

§ 307. The temperature of this water, at the various extremes, in which the others were tried, by the ſame thermometer, § 94, 140, 171, 199, 236, 271; as 50, 51, to 66, 84; a degree leſs cold than the laſt; which poſſibly might not have been, had not the baſon of the well been too large, and contained the water long enough to be altered more by the air, than the other, which is quicker diſcharged, can be.

§ 308. Next to Tonnelet, it appears the lighteſt upon the ballance; for, the phial, in which the others were weighed, § 95, 141, 172, 200, 237, 272; filled with this, of the ordinary temperature, 51, weighed ounces 6. 2.. 2. $5\frac{1}{2}$. But, when, like theſe, ſpoiled of it's volatile parts, by agitation, &c. the ſame volume weighed ounces 6. 2. 2. $7\frac{1}{2}$. There is alſo, nearly the like difficulty in filling the phial with this water, as with that; and much the ſame vacuity appears in the one and in the other, upon ſtanding cloſe ſtopped, after filling; and though this ariſes in ſome degree in all the waters of this claſs; it is evidently more apparent in theſe, than in any of the preceding, for the like reaſons, § 272. But, leſs in this, than in that.

§ 309. This is decompoſed by all the ſame means with § 92. 1. 2. 3. 4. 5. § 139, 170, 198, 273; but more like the laſt, 1. 2. 3. 4; except, that it is not ſo readily ſpoiled of it's acid, which ſeems to be ſomewhat more redundant, as well as of a more groſs and fixed nature. The later is further evinced by the following;

§ 310. 1. With the ſirup of violets, as in 97. 1. § 142. 1. § 173. 1. § 201. 1. § 138. 1. § 274. 1; it ſtrikes firſt a deeper crimſon, than the laſt; from which,

which, it more ſlowly changes to a roſe purple, and thence to a violet purple. In about three minutes, all tints of crimſon or red vaniſh, and leave the mixture of a bright, ſky blew. Soon after this appears at the highth, it begins like the laſt to change, but more ſlowly, to a pale, and by degrees to deeper ſhades of, green; but, hardly ever appears ſo deep.

2. The water lying the ſame time expoſed to the open air of the ſame temperature with the reſt, § 91. 1. § 139. § 170. 2. § 198. 2. § 235. § 273. or, like theſe agitated, while it explodes in a bottle; ſtill exhibits much the ſame appearances with the laſt, by itſelf or with this ſirup.

§ 311. Whence, the affinity of this water to the reſt, but particularly to the laſt, moſt planely appears, as does it's abounding more with an acid, of a more fixed nature.

§ 312. With the juice of the corn-blew bottle, as well as with blew paper, it gives ſtill ſtronger evidence of this; in the crimſon or roſe purple being deeper, and the change to green ſtill more ſlow and more pale in this than in any of the preceding. Whence, it lays the cleareſt clame to the titule of Acidula. The ſucceding will ſhew how properly it is to be ranked among the Chalybeatae.

§ 313. 1. With the infuſion of galls, as in § 100. 1. § 144. § 175. 1. § 203. 1. § 240. 1. § 277. 1; it hardly ſtrikes the tinge ſo ſoon as the laſt; but, upon ſtanding exhibits nearly the ſame appearances.

2. But, the water ſpoiled of it's air, by ſtanding, or by agitation, it is colored upon dropping, and ſoon, but not ſo quickly as the laſt, § 277. 2. ſtrikes it's deepeſt dye. Here, N° 1. 2. is alike proof with the reſt of this being a ferrugineous water, ſomewhat ſurcharged with acidity.

§ 314. After it has been quite ſpoiled of it's elaſtic air, and ſubtil ſpirit, and therewith loſſed it's pellucidity, taſte, ſmartneſs, and purple-tinging quality, by the like means with the reſt, § 100. 5. § 147, 177, 204,

204, 242, 278; all may, in the like manner and meaſure, be reſtored; whence, the ſame inferences are to be drawn as in the laſt cited paragraph. But, to give further proof of the being and nature of this ſubtil acid;

§ 315. This wrought the ſame effects upon the filings of iron, with thoſe mentioned in § 279, 280, 281; Hence, it equally merits the titule of Acidula and Chalybeata.

§ 316. The ſpirit of ſalt ammoniac, with quick lime, as in § 106, 151, 181, 210, 246, 282; produced effects analogous to the laſt.

§ 317. The ſpirit of ſalt ammoniac, with a fixed alcali, as in § 107, 152, 182, 211, 247, 283; correſponded with the reſt; but, moſtly with the laſt; than which, however it produced an ebullition ſeeming ſomewhat ſtronger.

§ 318. 1. The alcaline ley, as in § 108, 153, 183, 212, 448, 284; produced the ſame effects, as in the laſt, and for the ſame reaſons. The precipitation rather more prompt; probably, from the acid's being more groſs. 2. I took twenty pints of this water at the fountane, and ſaturated it, by inſtilling a pure alcaline ley, while it cauſed any milkineſs or ſeparation of terrene parts. It got none of the urinous or lixivial taſte of the alcali. I then filtrated it carefully, and evaporated it ſlowly towards a dryneſs, watching for the appearance of a pellicule, which imperfectly appeared towards the end of the operation, about the edges of the veſſel. I let it ſtand quiet in a cold place, for twenty four hours, and found ſeveral fair, diſtinct cryſtals formed, chiefly in priſms, that might paſs for nitre; of which, abſtracted from the alcaline ley, that adhered to them, they had much the taſte. There was but a ſmall portion of this, that would cryſtalliſe upon a repetition of the evaporation. The cryſtals did not ſtand well in the air; being apt to run into a mere alcaline ley, by loſing the volatile acid and reſorbing the humidity of the atmoſphere. Upon pouring

pouring the ſtrong acid of vitriol upon it, it gave a ſubtil, pungent, inviſible exhalation, and left vitriolated tartar. Being thrown into an ignited crucible, it emitted the like exhalation, fuſed and gave a pure alcali, as before. In this, it loſſed better than one fourth of it's weight. Thus, it appears, that this artificial ſalt did not eſſentially differ from the natural ſalt of the water. The one had the mineral or natural, the other, the vegetable or artificial alcali added to it's baſe. This experiment ſuccedes alike with the other waters. This appearing the moſt acid, I choſe it for the larger trial.

§ 319. 1. In this, all the acids cauſe the like commotion, as in § 110, 154, 184, 213, 249, 285, ſuperior to all but the laſt, to which it is inferior. 2. And, deprived, by whatſoever means, of it's air and acid, the commotion is diminiſhed in proportion. 3. Yet, by agitation, this is not eaſily ſpoiled ſo effectually of this acid and air, as not to ſhew ſome contraſt upon the mixture of the ſtronger acid of vitriol. Theſe are explaned in the laſt cited paragraph, 1. 2. 3. 4. Allowing this to contain a groſſer acid than that.

§ 320. 1. The ſolution of ſope, as in § 113. 1. § 155, 185, 214, 250, 286; is decompoſed by the water, in the natural ſtate, moſt effectually of any; but, 2. it mixes with it, in proportion as it is by ſtanding, by agitation or other means deprived of it's acid; for reaſons pointed out, § 113. 2.

§ 321. Yet, notwithſtanding it's evident acidity, and the likelihood of it's acid's being of a more fixed or groſs nature; it is ſtill ſubtil and volatile enough to make no more change in milk, cold or hot, than the reſt were obſerved to effect, § 114, 156, 186, 215, 251, 288; and for the like reaſons, § 114.

§ 322. 1. The ſolution of corroſive ſublimate cauſed the like ebullition, as in § 116, 157, 187, 216, 252; but leſs than in § 288; and none other ſenſible

ble effect. 2. When ſpoiled of it's air and acid, it cauſed no more ebullition.

§ 323. The ſolution of mercury wrought effects ſimilar in this, to theſe of the reſt, but neareſt to § 289, with no perceptible ebullition.

§ 324. The ſolution of lead cauſed the like appearances and effects, as in § 290; and for the ſame reaſpns, § 121. but, the ſlighteſt ebullition. For reaſons by the preceding made obvious.

§ 325. The ſolution of ſilver, all to the want of ſome ebullition, produced analogous effects in this to thoſe in § 291, and for the reaſons aſſigned, § 123. The precipitate more upon the purple, of the red roſe caſt: Which, I judge is to be aſcribed to the ſuperabundance of the ſubtil acid, here rather more groſs.

§ 326. The phaenomena attending the deſtillation of this, performed by the ſame apparatus, correſponded with that of the reſt, § 124, 161, 191, 220, 256; but moſt of all, with that of § 292. The color inclining more to a brown than a red.

§ 327. The deſtilled liquor of this, § 326, was by no ſenſe or experiment to be diſtinguiſhed from that, § 293. Which gives it an equal, if it has not a ſuperior, titule to the denomination of Acidula.

§ 328. The liquor remaning after the deſtillation, in the operation, had the like appearances and effects, and after the operation, anſwered the ſame trials with § 294; retaining it's purple tinging quality with the ſirup of violets, as well as with the infuſion of galls rather ſtronger than that. Which, I attribute to a groſſer acid.

§ 329. Twenty pints of this water ſlowly evaporated to a dryneſs, yield very nearly the ſame appearances with § 295. But, as ſoon as the firſt terrene, the ochrous parts begin to ſeparate, it ſhews a brown, inſtead of a rediſh muddineſs; and when finiſhed, the reſiduum appears of a bright umbre, inſtead of an ochre or bole, color, with ſome ſhining, ſelenite ſparks.

§ 330.

§ 330. This quantity of the water decompoſed by boiling, left near eleven granes of this kind of earth in the filtrating paper; which, in all things but it's looks, correſponded with that of the other waters. It was of a darker color; but, it ſtood all the teſts of § 127. 1. 2. 3. 4.

§ 331. The water ſpoiled of this earth, after filtration and upon evaporation, exhibits much the ſame appearances and effects with § 297; and being reduced to a dryneſs, weighed above nine granes.

§ 332. This maſs waſhed, as § 130, gave a liquor of the ſame color with that of § 225; with which, in taſte and other qualities, it correſponded; leſs lixivial and alcaline: For,

§ 333. Theſe waſhings, evaporated to a dryneſs, gave but little more than three granes of a ſalt, in all reſpects correſponding with the preceding.

§ 334. The terrene, non-metallic parts remaning in the filtrating coffin, well waſhed and dried, weighed near ſixteen granes, and upon the ſame trial, with § 134, 135, 167, 194, 227, 263, 300, appeared to conſiſt of about equal parts of ſelenite and calcarious earth.

§ 335. Hence, this alſo may be conſidered as a water impregnated upon the ſame principles, with ſimilar ingredients, in different proportions; hence, differing accidentally, rather then eſſentially. Wherefore it's properties and virtues can not be deemed very remote from the reſt, particularly from the laſt.

VIII. *Of*

VIII. *Of the Great Fountane of* CHEVRON *or* BRU, *in the Principality of* STAVELOT.

With pure Reſpect and Attention,
To the accompliſhed Gentleman,
The Man of Taſte;
Humbly preſented
To
RICHARD WARBURTON, ESQ;

§ 336. A Man, that ſees and overlooks this Great Fountane muſt be loſſed in perverſeneſs or inſenſibility. It has ever been looked upon with an evil eye by the proprietors or protectors of neighbouring medicated ſprings; who, have never failed ſtiring up emiſſaries to vilify and decry this formidable object of ſuch hold their dread and envy. And, though I grieve to tell it, has venality and corruption taken of the, once noble, faculty of phyſic, that in our days, a mercenary ſlave of the profeſſion can hardly be wanting to perpetrate the fouleſt deed,—upon the continent. Hence, not onely individuals have been always eaſily found, in this part of Germany, to write for and againſt any of the baths or mineral ſprings, to certify with ſolemnity the moſt palpable falſehood, but formal aſſociations have been formed, even among the incorporated bands of the phyſic-craft, that call themſelves the college of phyſicians at Liege, to pronounce the ſolemn condemnation of this water, of which, I have before inſerted a tranſlation. Let us now bring this

water to the ſame teſt with the reſt; give it a fair, a Britiſh trial, upon an appeal to the judicious and unprejudiced, and ſee in what light the former ſentences muſt ſtand upon an impartial enquiry.

§ 337. This ſpring, whoſe ſituation in the order, in which it occurred, appears in § 79. N° 15; here, demands the next to the Tonnelet or Sart, as by the following ſimilar experiments and obſervations will be made evident.

§ 338. Such is the rapidity, with which this great ſpring riſes and overflows, that it's ample baſon neither retains nor could receive any foulneſs of any kind. Nothing like a depoſite is to be ſeen in or about the baſon; except at the verge of the water, where the attraction of coheſion muſt occaſion ſome ſtagnation; for there, a little ſeam of bright, light, orange colored ochre is to be ſometimes found. This I judge neceſſary to aſcertain; as men who are capable of deſtroying it's reputation, may well be preſumed ready to infect it's ſource.

§ 339. In aſpect, this water exactly agrees with that of the Tonnelet and Sart, § 265, &c. 302, &c. As it is equally colorleſs and bright, ſo is it alike inodorous, though about it's ſource, the pyritous exhalation is very ſenſibly perceived.

§ 340. On the palate, it imprints a ſtrong, ſubacid, ſubaſtringent taſte, with an auſterity or roughneſs and a ſmartneſs, that are not diſagreeable, and a ferrugineous flavor hardly perceptible at drinking; though ſenſible in ſome time after.

§ 341. Upon taking up in a glaſs, it almoſt inſtantly begins to ſparkle, and covers the glaſs on the inſide and out, like § 269, 305. And poured from one glaſs into another, it ſparkles as briſkly, as the Pouhon water after bottling, and covers the glaſs all over with bright air bubbles.

§ 342. Upon ſtanding in the open air, theſe ſeparate and eſcape; and then, the water amits of it's pellu-

pellucidity and ſmartneſs, throws to the ſurface a pellicule of all colors, analogous to thoſe of § 270, 306. In twelve hours, it appears turbid, flat, and to taſte, almoſt inſipid

§ 343. I had not an opportunity of examining the temperature of this water at all the extremes of the atmoſphere, as I did the others. I found it as fivety two, to ſixty eight, and think it can not vary much from this.

§ 344. The phial, in which the other waters were weighed, § 95, 141, 172, 200, 237, 272, 308, filled with this of the ordinary temperature, 52, weighed ounces 6. 2. 2. 7, at the ſpring, the ſame quantity weighed again at Spa, is loſſed enough of it's volatile parts to weigh one grane more. The ſame difficulty in filling this void of air, and the like vacuity after filling appears in this as in § 272, § 308.

§ 345. This is decompoſed by all the ſame means with, § 92. 1. 2. 3. 4. 5. § 139, 170, 198, 270, 273. 306. 309; but more like the laſt but one, in all reſpects.

§ 346. 1. With the ſirup of violets, it correſponds in effects with § 310. 1.

2. After lying the ſame time expoſed to the ſame air, or agitated to the like degree; with the ſirup, it then exhibits the like color, as § 310. 2.

§ 347. With the juice of the corn blew-bottle and the blew paper, it likewiſe produces analogous effects with § 312.

§ 348. 1. With the infuſion of galls, as in § 100. 1. § 144. § 175. 1. § 203. 1. § 240. 1. § 277. 1. § 313. 1; upon dropping it ſhews clouds, firſt yellow, then of a brown, and then ſoon after of a violet purple all over; of which, the coloring matter, in about twelve hours, ſeparates and ſubſides; like the Pouhon.

2. After being ſpoiled of it's air by ſtanding or by agitation like the reſt, the infuſion at dropping

appears firſt milky, then of a kind of yellow, afterwards of a brown; then the mixture ſhews a deep ſcarlet, at the bottom, and a deep purple, towards the ſurface; and, upon mixture, all over. After ſtanding open for forty eight hours, it ſtrikes a Burgundy color.

§ 349. Being like the reſt, ſpoiled of it's natural ſenſible qualities; all may, in the like manner and meaſure, be reſtored. Confer § 100. 5. § 147, 177, 206, 242, 278, 314. Whence, the like inferences are to be drawn.

§ 350. Upon the filings of iron, this wrought the ſame effect, to all appearances, intents and purpoſes, with § 279, 280, 281, 315.

§ 351. The ſpirit of ſalt ammoniac, with quick lime, wrought the ſame changes, as in § 316; the precipitation larger, and of the color of that of § 282.

§ 352. The ſpirit of ſalt ammoniac, with a fixed alcali, correſponded with the reſt, but moſt with § 283; the precipitation of the like color, but in quantity greater.

§ 353. The alcaline ley, cauſed the ſame changes as in § 318. 1. the precipitation rather more colored. 2. And being therewith ſaturated, gave a ſalt quite analogous to that, in all reſpects. Thus, it appears, that this is a water, charged with the ſame acid with the preceding and all the reſt.

§ 354. All the acids produce the ſame commotion in this water, 1. in the natural ſtate, and 2. in the ſpoiled ſtate, as in § 319. 1. 2.

§ 355. The ſolution of ſope is as completely decompoſed in the perfect water, and mixes with the ſpoiled water, as in § 320. 1. 2; for the ſame reaſons, § 113. 1, 2.

§ 356. Yet notwithſtanding, it's apparent acidity upon every trial; it ſtill appears, that it's acid does not differ from that of the reſt; for, it is ſtill ſubtil and volatile enough to make no change upon mixture with milk cold or hot, no more than § 321; for the like reaſons, § 114.

§ 357.

§ 357. The ſolution of corroſive ſublimate cauſed none other change, than in § 322. 1. 2.

§ 358. The ſolution of mercury wrought the like changes in this as in § 289, 323.

§ 359. The ſolution of lead wrought changes like the reſt, but moſt to § 290. For reaſons in § 121.

§ 360. The ſolution of ſilver produced effects, not to be diſtinguiſhed from thoſe in § 291, and for the ſame reaſons, § 123. The color of the precipitate more like that in § 325; which is to be aſcribed to the ſame cauſe.

§ 361. In deſtillation, it exhibits, as near as ſenſes can diſcern, the ſame ſame appearances and effects, as thoſe of § 292.

§ 362. The liquor drawn off by deſtillation, in all reſpects agreed with that of § 293.

§ 363. The liquor remaning after this deſtillation, ſtood the ſame trials with thoſe of § 294, but gave leſs color with the infuſion of galls and leſs variety of colors and quicker changes with the ſirup of violets.

§ 364. Twenty pints of it evaporated ſlowly to a dryneſs, yield very nearly the ſame appearances with § 295; as the terrene parts begin to ſeparate, putting on more of the brown, than the rediſh muddineſs. This, the reſiduum retains, in a medium of color between that of the Tonnelet and that of Sart; and yields, to the quantity of thirty ſix granes; like the others, beſet with minute, ſhining ſpiculae, or flakes, of ſelenite.

§ 365. This quantity of water, decompoſed by boiling, upon filtration, depoſed near fourteen granes of an ochrous earth, of a bright brown, near what the painters call a Spaniſh brown, color. It ſtands all the teſts of § 127. 1. 2. 3. 4.

§ 366. The liquor, ſpoiled of this earth, affords the ſame appearances and products, by evaporation, with § 297; and, being reduced to a dryneſs, gives a foliated maſs, weighing nearly twenty two granes.

Which, freed from their ſalt by waſhing, weighed twenty granes, and appeared to conſiſt of a calcarious earth and ſelenite, nearly in the ſame proportion with the preceding.

§ 367. This maſs, waſhed as that of § 130, gave a liquor, in color and partly in qualities, correſponding with that of § 332.

§ 368. Theſe waſhings, evaporated to a dryneſs, afforded about two granes of a ſalt correſponding with that of the preceding, § 333.

§ 369. What room have we then, to ſuſpect any virulent qualities in this, that are not found in all the other mineral waters of this claſs? Does it not appear impregnated upon the ſame principles, with ſimilar ingredients, differing onely in proportions? Why then, may not the like properties and virtues be aſcribed to this, as to the others, as in fact there ſhould be, allowing onely for theſe differences, which appear rather accidental than eſſential? Have the defamers of theſe waters purſued the analyſis this length? Have they made any analyſis? By their declaration, it is moſt plane, they have not. Hence, judge of their condemnation! It is onely of equal weight with their approbation. Both alike are nugatory.

§ 370. In the houſe belonging to the fountane, I ſaw ſeveral flaſks, that had been filled ſome months, others from one to four years, and ſome that had layen by accident neglected, beyond the recollection of the keeper; but long enough to rot the wicker of the flaſk, and in a great meaſure, the leather, with which it had been tied over. Yet all, from firſt to laſt, appeared in the utmoſt perfection, briſk, ſmart and ſparkling, upon opening. The acid alone ſeemed to have undergone ſome change in keeping confined: For, it ſtruck a deeper crimſon with the ſirup of violets and held it longer than the new water, and did not ſo ſoon turn green. Nor did did it ſo readily ſtrike the color with galls; but,

upon

upon ſtanding, it came to the ſame pitch. The oldeſt had more of the red in it's purple. In ſhort, by keeping, it ſeems to have ſuffered juſt what fermented liquor does by bottling; a change, which all of this claſs, more or leſs undergo.

IX. *Of the Fountanes, called* COUVE *and* BEVERSEE, *near* MALMENDY.

With due Reſpect and Gratitude,
Preſented
To
SIR KILDARE DIXON BURROWES,
Baronet.

§ 371. THESE fountanes, which in the general view appear in § 66. 67. N° 11. come here under conſideration, from their affinity to each other, in nearly the ſame point of view; though they do not properly, immediately follow the preceding.

§ 372. The firſt may be placed in a medium betwixt the Tonnelet, § 265, and the Watroz, § 196. It hardly equals the pellucidity, ſmartneſs, briſkneſs and generous vinous taſte of the former; but greatly outdoes the later. It gives the ſame products in deſtillation, and in evaporation, in proportions and qualities nearly with the Tonnelet. And grows rather more ſmart and briſk upon bottling. Some flaſks carefully filled with it, corked and cemented at the ſpring, on the ſecond of September, 1752, were examined again at Spa in three days after. The flaſk at opening made a loud exploſion, and then by ſparkling gave a loud hiſſing noiſe. Upon pouring it out into a glaſs gently, it not onely ſparkled in a moſt extraordinary manner, throwing ſome larger globules ſome inches above the ſurface of the water, but raiſing a thick miſt, like an atmoſphere, of the dimenſions of three or four inches above and about it, continuing ſix or eight ſeconds; whileſt it covered the glaſs thickly with very bright air bubbles. After

ſtanding

ſtanding in the open air expoſed for upwards of twenty four hours, it retains it's purple-tinging quality with galls. I brought ſome of it with me in great perfection to London: For, it ſtood all the trials, allowing for the difference between an unbottled and a bottled liquor; it ſuffered a change, in, but, no loſs of it's parts.

§ 373. The ſecond, BEVERSEE, bears great affinity to the firſt; but, is inferior to it, chiefly from it's lower ſituation and ſlower diſcharge; and therefore, inclining more to the Watroz. The ſolid contents of this, correſpond in quality to thoſe of the preceding; but differ in proportion: For, that gives but twenty granes, this gives twenty four in twenty pints. The former weighs a grane more than the Tonnelet; and this half a grane more than that. BEVERSEE is not quite ſo ſmart upon keeping. But, were it not outdone by COUVE, it muſt be much admired; ſince the more indifferent may be accounted a moſt excellent water in it's kind.

X. *Of*

X. *Of the Fountane of* La Sige, *near* Malmendy.

With the moſt perfect Reſpect and Affection,
To a man, that dares eſpouſe the cauſe
Of Merit in Obſcurity,
And Virtue Oppreſſed;
To the ſteady, active Friend,
The accompliſhed Maſter of his Profeſſion,
Devoid of it's Arts;
Humbly preſented
To
EZEKIEL NESBITT, M.D.
Of the King and Queen's
College of Physicians in IRELAND.

§ 374. THE ſituation of this ſpring has been pointed out, § 68. N° 12. Here, we are to examine it's ſenſible qualities and other properties by experiment. And though all the waters of this diſtrict, of this claſs, hold much in common, the one with the other, as thoſe of that of Spa; which may make it poſſible to compare them to each other, like thoſe; yet, as there is ſome conſiderable diſparity in this and the following; I judge it will be more ſatisfactory to give a more particular detail of the experiments, in the ſame order with the reſt.

§ 375. In aſpect, this agrees with the brighteſt and moſt colorleſs; nor has it any more ſenſible ſmell than the reſt, nor the adjoining ſoil ſo much, as that of moſt others. Confer, § 339.

§ 376. To the palate, it is moderately ſubacid, pleaſantly ſmart and gratefully vinous; without imprinting any ſenſe of the ferrugineous. § 340.

§ 377. Upon taking up, it preſently begins to ſparkle ſmartly in the glaſs; but, upon being poured from one into another, it is nearly equal to Champagne in ſparkling, but does not frothe. § 341.

§ 378. Upon ſtanding in the open air, in a few hours, it loſes it's air and volatile ſpirit, covers the glaſs with bright air-bubbles, and ſoon after, throws up a thick, muddy, mother of pearl colored pellicule; loſes it's pellucidity, grows turbid, and ſoon after lets a yellowiſh ſediment in clouds ſubſide. Then, it loſes it's flavor, grows flat and vapid, imprinting onely a kind of vitriolic, or rather ochrous reſtriction on the palate.

§ 379. It's temperature, by the ſame Thermometer with the reſt, is as 52, 53, to 68, 84.

§ 380. It's weight, in the ſame phial with the reſt, § 344, of the ordinary temperature in the natural ſtate, is ounces 6. 2. 2. 7. and almoſt an half. But, bereft of it's air, &c. by agitation, it increaſed in weight, volume for volume conſidered, above one grane and an half. The ſame appearances attending the filling it, as in § 272, &c.

§ 381. It is decompoſed by all the ſame means with § 345 and the reſt, but the moſt readily.

§ 382. 1. With the ſirup of violets, in the natural ſtate, it ſtrikes firſt a blew, in leſs than a minute a pale, and then a thorough green, all over. In twelve hours, it appears of a muddy graſs green. 2. The ſirup, with the water, after it is by agitation or otherwiſe diveſted of it's air, gives a green, upon mixture.

§ 383. 1. In the natural ſtate, it changes blew paper to a crimſon firſt, and then to a purple. 2. Deprived of it's volatile parts, it reſtores the ſtained paper to it's priſtine color; and 3. does not alter the firſt.

§ 384.

§ 384. 1. With the infuſion of galls, the water in perfection ſtrikes a Burgundy color, ſome few ſeconds after mixture; which very ſoon after highthens to a claret color; and not long after grows opac, muddy and looks as if milk had been mixed with it. The next morning, the coloring matter was found fairly precipitated; the ſupernatant liquor, ſomewhat turbid and greeniſh. 2. After ſtanding a while or upon agitation to diveſt it of it's air, it more immediately ſtrikes the ſame color, and ſooner coagulates and precipitates the coloring matter.

§ 385. Being by the above means bereft of it's air and volatile acid, and therewith ſpoiled of it's natural, ſenſible qualities, purple tinging effects, &c. they may all, in ſome meaſure be reſtored by the addition of a very ſmall portion of the vitriolic acid; which enters with a commotion, from the redundance of abſorbent earth in this water.—Confer, § 349.

§ 386. It's action on the filings of iron correſponds with thoſe of 350, and the reſt. It is more powerful than the Couve in this ſolution. It then, dyes deeper with the galls than at firſt, but ſoon coagulates. It's product on evaporation is much greater. But the iron loſes but two granes.

§ 387. The ſpirit of ſalt ammoniac, with a fixed alcali; every drop cauſed a white cloud, which turned yellowiſh, and gradually ſubſided, retaining it's color. Confer § 352.

§ 388. The alcaline ley wrought the like effect more quickly and ſenſibly.

§ 389. All the acids, from the ſtrongeſt mineral, to the mildeſt vegetable acid, deſtilled vinegar, cauſe a quicker and ſtronger ebullition, upon mixture with this, than with any other of theſe waters. And different from them, this effect remanes after it is ſpoiled of it's volatile parts. Which is not to be wondered at, when the quantity of the precipitate with alcalies, of the remanes after evaporation, and it's abſorbent quality are conſidered. § 399. and following.—

§ 354.

§ 390. 1. The ſolution of ſope is preſently decompoſed in the water in the natural ſtate; 2. but ſlightly coagulated onely, after it is bereft of it's volatile parts.

§ 391. Though it thus appears to contain an acid upon every trial; yet, it ſo far agrees with that of the other waters, as to make no change in milk. § 356. § 114.

§ 392. The ſolution of corroſive ſublimate, beſides an ebullition, cauſed none other change different from the preceding water, § 357.

§ 393. The ſolution of mercury works a more ſenſible effect in this than in any other; § 358: For, one drop cauſed as great and a more colored precipitation, than ten in the preceding. The precipitate at bottom is of an orange color; over it, paler and the glaſs coated with the ſame: An argument of greater terreſtreity.

§ 394. The ſolution of lead alſo works a more ſenſible effect than in any of the reſt. The precipitate appears more than four fold, not quite ſo white and covered with lighter, yellow clouds: For reaſons ſimilar to thoſe of the preceding §.

§ 395. The ſolution of ſilver produces effects analagous. One drop cauſes a general milkineſs and a pearl opacity, with a ſmart ebullition. The precipitate took a purple hue at firſt, and after ſome hours, appeared of a dark, umber brown.

§ 396. In deſtillation, it produces the ſame appearances and effects as § 361. as far as ſenſes can compare them; with this onely difference, that the ſparkling and ebullition is more quick and rapid, and the loſs of brightneſs, and conſequent turbidity, of a paler color, more prompt.

§ 397. The liquor drawn off by deſtillation, upon all trials correſponded with the reſt; § 362.

§ 398. The liquor remaning after deſtillation, is turbid, of a very pale brown, that, commonly called a creme color; cauſes an ebullition with acids; 2. turns inſtantly of a muddy olive green, with ſirup

of

of violets; 3. Does not change color with the infuſion of galls, but grows milky, and upon ſtanding, greeniſh.

§ 399. Twenty pints evaporated to a dryneſs yield 160 granes of a pale brown, or dark creme color, conſiſting chiefly of a variety of ſucceſſive pellicules, which give it a foliated or lamellated form; with ſome ſmall ſhining ſpiculae, which might paſs for ſalt; but, from their inſipidity, are apparently ſelenite.—Eight granes to the pint.

§ 400. It was was not eaſy to ſeparate the martial from the other terrene parts by decompoſing this water. We can therefore onely gueſs at the proportion of it's impregnation with iron, by comparing it to the others, whoſe metallic parts are firſt and alone ſeparated. It is at it's higheſt tinge with about an eighth part of the infuſion of galls, that the Tonnelet requires to ſtrike it's deepeſt dye. To this, it's dye is greatly inferior. Whence, it may be preſumed, it does not contain near one eighth of the iron, with which that is impregnated. In general, it will be found, that the more earth, the leſs iron, all waters contain.

§ 401. This mixed maſs, waſhed as that of § 130, 370, hardly colored the water.

§ 402. The waſhings, being filtrated and evaporated to a dryneſs, gave twenty granes of a ſalt very ſlightly colored at the edges, with the oily matter. This increaſed it's weight, upon lying the ſame time with the others expoſed to the air, to near double. Yet, it was not ſo pure an alcali: For, it taſted muriatic, and gave fumes like thoſe of ſea ſalt, with the acid of vitriol.

§ 403. The terrene parts thus waſhed and dried, weighed 140 granes.

§ 404. Theſe all to thirty two granes of a ſmall, bright, ſhining flakey ſubſtance, diſſolved in the acid of ſalt. Conſequently, 108 granes of it is a calcarious

rious earth, and 32 granes, ſelenite, and 20, ſalt, of the nature before ſet forth; § 402.

§ 405. This then, appears a water impregnated upon the ſame principles, and with the like ingredients with the preceding, in different proportions. Whence, it appears properly in the number of the Acidulae Chalybeatae.

XI. Of

XI. *Of the Fountane of* GEROMONT, *near* MALMENDY.

From pure Reſpect and Attention
To the moſt juſt Senſe of Valor and Honor,
To the moſt extenſive Humanity
And Good Manners;
Humbly preſented
To
COLONEL BROWN.

§ 406. AS this medicated ſpring, in the general view, ſtands § 72. N° 13. neareſt to LA SIGE, ſo does it by affinity, the order of nature, come next to that Fountane. It holds the common affinity to the reſt of the waters of this claſs in general, of this diſtrict in particular. Yet, I judge it of importance enough to recite the comparative analyſis of it, as nearly as may be, in the like point of view with the preceding.

§ 407. In aſpect, this water is colorleſs, extremely pellucid and bright. It is quite inodorous; and as it's overflowings are conſtantly waſhed off by the neighbouring rivulet, little or none of the pyritous exhalations, that attend moſt of the other ſprings of this claſs, are here obſervable. Confer, § 375.

§ 408. To the taſte, it appears endued with the ſame qualities with § 376; but in an higher degree; for, it is ſtill more ſtrong, more vinous and grateful.

§ 409. Upon taking up in a glaſs, it as ſoon begins to ſparkle and as briſkly. But, in a few minutes grows milky, from the loſs of the volatile ſpirit, that is the cauſe of this commotion, as well as of it's impregnation. And, upon ſtanding a few hours,

hours, in the open air, it ſo far loſes it's elaſtic air and volatile ſpirit, by diſſipation or depoſition on the ſides of the glaſs, as to grow turbid; to cover it's ſurface with a ſlight, pale, mother of pearl colored pellicule; after which, all appearances of air bubbles vaniſh; it loſes it's ſmart, ſprightly taſte, and, in it's ſtead, gets the flavor of vapid white wine. § 378.

§ 410. In temperature, by the ſame thermometer with the reſt, it is as 51, 52, to 68, 85.—§ 379.

§ 411. It's weight, in the ſame phial, § 380, of the ordinary temperature, in the natural ſtate, is ounces 6. 2. 2. 7; about half a grane leſs, than the laſt, though colder; becauſe it then contains more volatile parts. But, being deprived of theſe by agitation or expoſure, it increaſes to ounces 6. 2. 2. 9, about two granes more; the proportion of ſolid contents being equal. It is attended with the like difficulty and appearance upon and after filling the phial or a bottle with it.

§ 412. It is decompoſed by all the like means with § 381; but more readily; except in agitation; for then, this gives ſix exploſions; when that, with the like concuſſion, gives but four.

§ 413. With the ſirup of violets, 1. in the natural ſtate, it inſtantly ſtrikes, firſt upon mixture, a bright blew; in leſs than a minute, a pale green, which improves for twelve hours; when it is found a very beautiful, thorough green. 2. in the ſpoiled water, it gives a fair green upon mixture.—§ 382. 1. 2.

§ 414. The 1. ſtains the blew paper, more upon the roſe than the violet, in purple. The 2. reſtores the ſtained paper to it's priſtine color; and 3. does not alter the firſt paper.—§ 383. 1. 2. 3.

§ 415. With the infuſion of galls, 1. the water, in a ſtate of perfection, ſtrikes a Madeira color, in ſome ſeconds after mixture; which gradually improves to a Burgundy color. In about twelve hours, the coloring matter appears in vermillion clouds precipitated, the ſupernatant liquor being turbid and green-

iſh. 2. The water, ſpoiled by ſtanding a few hours, or by agitation, gives the ſame color upon mixture; and alſo ſooner coagulates and ſubſides.—§ 384.

§ 416. Being ſpoiled, by the above means, of it's volatile parts, and thereby of it's natural ſenſible qualities, it's faculty of tinging with galls, &c; they may, in a great meaſure, be reſtored by the addition of a ſmall portion of the vitriolic acid; which upon inſtilling, in the ſmalleſt quantity, cauſes the like ebullition, as in § 385.

§ 417. It's effects on the filings of iron correſpond exactly with thoſe of § 386.

§ 418. The ſpirit of ſalt ammoniac, with a fixed alcali, produced effects analogous, but inferior, to thoſe of § 387, and leſs colored.

§ 419. The alcaline ley wrought effects analogous to the preceding, more to thoſe of § 388, but the clouds and precipitation, inferior in quantity and color.—This and the preceding will be explaned, when the nature of the ſolid contents of each water are compared. § 427, to 432.

§ 420. All the acids ſhew the like contraſt in this as in § 389, in the natural and ſpoiled ſtates; but in an inferior degree. Which will not be wondered at when the ſolid contents fall under conſideration; §427.

§ 421. The ſolution of ſope correſponds in effects with § 390.

§ 422. It agrees in the ſame manner with milk as the reſt of this claſs. § 391.

§ 423. The metallice ſolutions all correſpond in effects,

1. That of corroſive ſublimate, with an ebullition, a ſlight milkineſs, and an inconſiderable white precipitation, with a pellicule like the reſt.—§ 392.

2. The ſolution of mercury, in double the quantity, produced the ſame appearances as in § 393; and for the ſame reaſons.

3. The ſolution of lead wrought ſimilar, but inferior, effects.—§ 394.

4. The

4. The ſolution of ſilver gave appearances much alike; but the precipitate was more upon the purple hue, and retained it.—§ 395.

§ 424. In deſtillation, the effects agree all to this, that the Geromont is not ſo ſoon ſpoiled, nor ſo deeply colored, when ſpoiled by heat, as LA SIGE; § 396.

§ 425. The product of the deſtillation alſo correſponds with § 397 and the reſt. So that the acid appears the ſame in all.

§ 426. The remaning liquor is of a paler color and not quite ſo turbid, as that of § 398.—1. It cauſes a ſlighter ebullition with acids; 2. turns, but not quite ſo ſoon, to a muddy ſea green, with the ſirup of violets; 3. grows onely milky and greeniſh with the infuſion of galls.

§ 427. Twenty pints, evaporated to a dryneſs, yield the like appearances, of a paler color, the like quantity, 160 granes; eight to the pint.—§ 399.

§ 428. It was near as difficult to ſeparate the martial, from the other terrene parts, in this water, as in § 400. It's proportion of iron can onely be judged, like that, from it's tinge, to be analogous.

§ 429. Theſe 160 granes waſhed as § 130, § 401, hardly colored the water.

§ 430. The waſhings, being filtrated and evaporated to a dryneſs, gave of a lamellated ſalt, hardly at all colored, 68 granes. This expoſed to the ſame air, the ſame length of time, with the other, § 402, increaſed but thirty two granes in weight. The part remaning undiſſolved in the air, taſted like ſea ſalt, mixed with the mineral alcali; and gave white muriatic fumes and a ſtrong ebullition, with the vitriolic acid. Hence, it differs onely in quantity from the former.

§ 431. The waſhed terrene parts, weighing, 92 granes, in the acid of ſea ſalt, diſſolve all to ſixteen granes, which appear to be ſelenite. § 403. 404.

§ 432. Conſequently, this water differs onely in proportion of ingredients from the preceding. The acid ſpirit ſeems in this, ſuperior to that. The pint

of each yields eight granes of ſolid matter, upon evaporation. Of which, I judge about one ſixteenth part of a grane to be iron, in each. And in LA SIGE, one part in eight is ſalt; about five granes and three quarters is calcarious earth, and leſs than a grane and three quarters ſelenite. In this, about three granes and three quarters are ſalt; about as much calcarious earth, and about three quarters of a grane, ſelenite. Thoſe, that judge greater exactneſs neceſſary, may go to fractions. From theſe experiments, the ſame inferences as in § 405 are to be drawn.

XII. *Of the medicated ſprings of* TUNBRIDGE.

With all due Reſpect and Humility,
Inſcribed
To the Right Honorable
The EARL of ORFORD.

§ 433. TUNBRIDGE ſprings, though inferior in rank, will be found to clame a place in this claſs. There are ſeveral ſprings about this village, of which, the chief part ſeems to have been built, as it is ſupported, by theſe water's being introduced into medicinal uſe.

§ 434. The village lyes twenty ſix miles ſouthward of London, in the county of Kent, in a rude country, and immediately about the wells, is environed with a barren, ſandy and loamy ſoil, in ſome parts rocky. The common ſtone, a crumbling, ſand-ſtone.

§ 435. Four ſprings have been chiefly opened, and, in their turns, uſed at Tunbridge. And there may be as many more. But, as there has been none extraordinary variety as yet diſcovered, it is immaterial, which of them is taken, or examined; for, provided, they are alike drawn and cleaned, none eſſential difference is obſervable.

§ 436. Two ſprings are now principally uſed. They lye within a few feet of each in a valley; for, from every ſide, there appears a deſcent to them. The adjoining ground of a triangular form is incloſed with an handſom lofty wall, with a large gate, opening to the ſouth.

§ 437. The ſprings are ſurrounded with a paved area, and, each ſpring has an hollowed, ſtone baſon ſet into it, with perforations in it's bottom; ſo that all

the water of each ſource, paſſing through theſe perforations, fills the ſtone baſon, as it ſprings up from the bottom; while it's overflowings are diſcharged by an opening on one ſide, in the edge of the ſtone baſon. This is a ſenſible and elegant contrivance. The baſons are each large enough to hold as much water, as may be collected together without ſpoiling; and in ſuch a manner, as they may be emptied without ſullying the ſpring.

§ 438. At the entrance into this incloſure from the ſouth, one ſpring lyes to the eaſt or at the right hand, the other to the weſt or at the left. The former is by ſome called the old ſpring, perhaps onely from being pretty much neglected. The later is called the new, and is that, which is moſt uſed.

§ 439. This, I ſhall chooſe for mine examination; but, as I have analyſed the reſt, where any obſervable difference ariſes, I ſhall point it out.

§ 440. This water ſprings pretty briſkly, with ſome air bubbles by uncertain intervals. It furniſhes ſome hundreds of drinkers, in the drieſt ſeaſons, and when it is not much drawn, overflows and depoſites a fine, ochrous earth in it's channel, of color, between yellow and orange.

§ 441. I ſhall here ſet down mine experiments and obſervations, on theſe, in the order, I made them on the German chalybeate ſprings; that the reader, that chooſes it, may the more readily be able to compare thoſe of Tunbridge to that ſpring, to which they bear the greateſt affinity; which, though remote, appears to be the Watroz, § 196.

§ 442. This water at the ſpring is colorleſs, clear and bright. The colder and drier the weather, the more the water excels in theſe qualities; the warmer and moiſter, the leſs.

§ 443. It has hardly any perceptible ſmell, though about the ſource, ſome pyritous exhalations are ſometimes perceptible.

§ 444.

§ 444. In taſte, it is not ſenſibly ſubacid or auſtere, but is ſlightly ferrugineous.

§ 445. It does not ſparkle immediately upon being taken up; but, being poured from one glaſs into another, or upon ſtanding ſome time, it ſparkles, ſooner or later according to the heat of the air; but, at all times ſo ſlowly, that the air is rather depoſited in globules on the ſides of the glaſs, than ſeen to fly off in bubbles. The air, that thus ſeparates, adheres above twenty four hours to the glaſs.

§ 446. Set ſtanding in a glaſs, in a warm atmoſphere, after thus depoſiting it's air, it begins to put on, firſt a milky aſpect, and then by degrees, to grow muddy all over. Viewed, after ſome hours ſtanding, a pale, diverſicolored pellicule covered the ſurface; it appeared milky all over, with ſome yellowneſs in the upper part. Many air bubbles lined the glaſs; but chiefly towards the bottom, where it continued alſo the longeſt bright. In proportion then, as it loſes it's air, it decompoſes, grows turbid, and lets an ochrous earth ſubſide, ſuch as it depoſites in it's courſe.

§ 447. As this earth ſeparates from the water, it loſes it's property of tinging purple with galls and other aſtringents. Of this, it is totally ſpoiled in leſs than twenty four hours.

§ 448. 1. Expoſed to the open air of the temperature of 74 degrees, for about three hours, it loſes it's pellucidity and appears milky. 2. Set in the receiver of an air pump and exhauſted for a few minutes, it alſo loſes it's pellucidity. And 3. Set on the fire, it ſparkles and readily diſcharges itſelf of it's air in little globules, which do not riſe above the ſurface of the water. By the time, it becomes heated to the ſame degree with the atmoſphere, it loſes it's pellucidity. By ſpoiled water, I mean one or other of theſe. When I do not mention ſpoiled, the water in the natural ſtate is to be underſtood.

§ 449. The temperature of the ſpring, by the ſame thermometer, uſed in § 199, is from 54 to 55, be-

tween the ſeveral variations of the atmoſphere from 66 to 85. The other ſprings are not ſo cold, when the air is moſt heated.

§ 450. A phial, with a ground ſtopple, weighing ounces 2. 4. 0. 15. filled with deſtilled water, of 55, weighed ounces 4, 6. 0. 15.

§ 451. This phial, filled with the water of any of the ſprings, in the natural ſtate, or ſpoiled as above, do not ſenſibly vary in their weight; but, before and after, weigh alike the ſame with deſtilled water of the ſame temperature. This ſhews how ſlightly this water is impregnated; how inconſiderable the quantity of it's volatile parts muſt be; when it is ſo readily ſpoiled, and ſuffers no alteration in it's weight. Compare this to § 200.

§ 452. 1. With ſirup of violets, forty drops to two ounces, no ſenſible change; in about five minutes, it appears of a pale, ſea green, firſt at the ſurface, and ſoon after, all over. Not long after this, it gets a ſhade deeper, firſt at the ſurface and by degrees all over. Viewed in about five hours, it appears of a bright graſs green all over; but deepeſt next the ſurface. In about twenty hours, it ſhews a deep graſs green univerſally. 2. The ſpoiled waters inſtantly ſtrike a green with the ſirup, upon mixture.—This ſhews, that it is not ſufficiently charged with the volatile, acid ſpirit, to give any tint of crimſon or purple with the ſirup; and that it readily loſes the pittance of this ſpirit, that it contains. The green may ariſe alike from a ſolution of iron, abſorbent earths or alcalies. To aſcertain to which it may be owing, we muſt conſult ſubſequent experiments § 453. 1. &c. 456. The old ſpring has leſs of this ſpirit; for, it changes quicker.

§ 453. With different coloring matters, it gives evident indications of it's mineral impregnation.

1. With an infuſion of cochinell, four drops to two ounces, it gives a pale bloom, at mixture; which ſoon after turns to a light purple; then loſes of the luſtre

of

of it's color gradually; ſo that in five hours, it bears an olive color, ſeparated into clouds, which ſoon after, precipitate of that color.

2. The infuſion of logwood of Campechy, every drop cauſes a dark, olive colored cloud, as far as four, upon falling in; at mixture, an inky blew; which, upon ſtanding, improves to a beautiful violet; and retains it's color and brightneſs above twenty four hours.

3. The infuſion of galls, in the ſame proportion, ſoon after mixture, ſhews a roſe purple, which improves quickly to a deep purple, with much of the crimſon hue; and retains this beautiful color and brightneſs, upwards of twenty four hours.

§ 454. Here are demonſtrative proofs of an impregnation with iron, which appears to be by the means of aſubtil, volatile ſpirit, analogous in quality, but not in quantity, to that of the Spa waters in general. It's volatility, as well as it's paucity, appears from the aptneſs of the Tunbridge water to ſpoil; and yet, that there is ſome little redundance of it may be ſeen from the waters ſpoiled, changing ſooneſt green with the ſirup of violets, as well as ſtriking the purple dye more readily, when ſpoiled, before there be a viſible ſeparation of parts, than in the natural ſtate. Compare to § 201, to 205.

§ 455. The water, ſpoiled of it's volatile parts, may have all it's qualities in the natural ſtate, in a great meaſure reſtored, by the addition of a ſmall quantity of the vitriolic acid. § 206.

§ 456. All the acids cauſe more or leſs ebullition upon mixture with the water, in the natural ſtate; hardly any, when it is ſpoiled. They all preſerve it's fleeting pellucidity; and, if not made to predominate, continue it's tinging quality with galls, &c. though expoſed to the open air, long after it is loſſed in the water alone, though kept cloſe ſtopped. In this, the deſtilled vinegar ſuccedes the readieſt.

§ 457. Poured upon filings of iron, the air, that

was

was ordinarily ſeen to collect on the glaſs, is now onely ſeen in globules on the metal. But, it buoys up none of it. In five hours, it appears all over of a muddy, yellow milkineſs, with a pale, diverſicolored pellicule. In twenty hours, it bears the like appearance; but can not then tinge with galls, deeper than a Madeira color. Compare to § 207, 208, 209.

§ 458. The ſpirit of ſalt ammoniac, with quick lime, cauſes no commotion, but a milkineſs, which coagulates into pale, yellow clouds, which grow gradually, higher, towards an orange color, and ſlowly precipitate of the ſame aſpect.—§ 210.

§ 459. The ſpirit of ſalt ammoniac, with a fixed alcali, cauſes a ſlight, ſlow ebullition; the reſt as in the preceding.—§ 211.

§ 460. The alcaline ley gave ſome appearances of an ebullition, ſo ſlow and ſlight, that the ſmall air bubbles did not ſenſibly riſe to the ſurface. The other appearances, as with the volatile alcali; the precipitation rather paler, as well as more ſlow in forming. The fixed alcali concrete, gives a much ſtronger ebullition, than in common or deſtilled water.

§ 461. The ſolution of ſope, as far as thirty drops, cauſes onely a ſlight milkineſs at mixture, and continues ſo above twenty four hours, without any coagulation or other viſible ſeparation. Compare to § 214.

§ 462. It mixes ſmoothly with milk, cold or hot, and works no viſible coagulation or other change therein. Whence, the ſame inferences may be drawn as from § 215, 114, &c.

§ 463. With the ſolution of corroſive ſublimate, it cauſes a ſmall increaſe of ſparkling. After ſome hours ſtanding, a mother of pearl colored pellicule covers the ſurface; and the liquor appears all over milky, chiefly about the ſurface; where, it inclines to be opac and yellowiſh. Upon ſtirring, it becomes alike colored all over. In twenty hours, the glaſs appears coated, and a brown, ochre-like precipitate is found at bottom.—§ 216.

§ 464.

§ 464. The ſolut on of mercury cauſes a bright, white cloud at every drop, the whole liquor puts on a pearl milkineſs, but ſoon contracts ſome tinge of the lemon color, towards the ſurface. In ſome hours, a bright, mother of pearl colored pellicule ariſes; while a precipitate, of a pale yellow or obſcure white, is found at bottom.—§ 217.

§ 465. The ſolution of lead gives a ſlight, blewiſh milkineſs; which, in a few hours, ſubſides in a ſlight, white precipitate.—§ 218.

§ 466. The ſolution of ſilver, cauſes white clouds, at every drop. This gives a blewiſh milkineſs upon mixture, and ſoon changes to a pearl opacity. This gradually ſubſides, and as it is depoſited on the bottom and ſides of the glaſs, changes to a roſe purple or amethyſt color. In a few hours, viewed before the light, it appears of a kind of aſh-color; but, examned between the eye and the light, it ſtrikes a muddy blew, or deep ſlate color.

§ 467. It's products in deſtillation are very obſcure, upon compariſon with § 220, or any of the reſt. The ſparklings were but ſmall, and did not ſenſibly riſe above the ſurface of the water. It grew very ſoon milky and ſoon after muddy.

§ 468. The deſtilled liquor did not in any thing perceptibly differ from the common water of the place, deſtilled in the ſame veſſels. And the blew paper, placed in the junctures, was but ſlightly changed.

§ 469. The remaning liquor is not ſenſibly altered with the infuſion of galls; for, the martial earth, inſtead of being, as ſome idly ſuppoſed, volatile, is the firſt of the ſolid contents, that ſeparates and ſubſides.

§ 470. The water, ſlowly evaporated to a dryneſs, twenty pints yield ſeventy five granes of a dark, orange colored ochrous matter, with which the cup was more or leſs covered from the verge of the water to the bottom, where ſome oily circles lay, and more of this ochrous earth.

§ 471. After a boiling heat, the ochre ſeparates; and,

and, being parted by filtration, weighs fiveteen granes. It is a ſubtil powder, of nearly the ſame color with that, that the Tonnelet yields; and upon all the experiments, appears to be a martial earth; of which, we have about three quarters of a grane in the pint.—§ 223.

§ 472. The water, thus ſpoiled of it's martial earth, evaporated to a dryneſs, yields ſixty granes of a pale or white mixed ſubſtance, colored with the oily matter, conſiderably, about the edges.—§ 224.

§ 473. This waſhed and filtrated, as § 130, leaves thirty granes of an aſh-colored matter, inſoluble in water, in the coffin.

§ 474. The waſhings, are colored, like thoſe of the Watroz; and, being evaporated to a dryneſs, yield thirty granes of a ſalt-like ſubſtance, colored with the oily matter, nearly as that of the Watroz; but, upon experiments, anſwering none of the characteriſtics of that, § 226, or any of the reſt. 1. They do not change ſirup of violets; 2. They are rendered turbid with alcalies; 3. Cauſe none ebullition with acids; 4. Give acid, white fumes and ſelenite, with the acid of vitriol.

§ 475. The terrene parts, ſeparated by waſhing and filtrating the reſiduum of § 474, partly diſſolve in the acid of ſalt, with an ebullition, and partly remane in ſhining, thin laminae; ſo that it is in part a calcarious earth, in part ſelenite.

§ 476. Hence, we may reaſonably conclude, that this is a water, ſlightly charged with the like volatile, acid, mineral ſpirit, with others of this claſs, but in a ſmaller proportion. That by this means, it becomes, like the reſt, impregnated with iron, with ſea ſalt, abſorbent earth and ſelenite; upon the like principles with the reſt, but different in proportion; it's ſalt being, inſtead of alcaline, muriatic, and it's deliqueſcence ariſing from the ley of ſalt or bittern.

Of

Of the medicinal Virtues of theſe SUBACID, FERRUGINEOUS WATERS.

§ 477. THERE is no part of the Materia Medica ſo ill underſtood, and conſequently ſo ill adminiſtred, as mineral waters in general, the ferrugineous, or as they are more vulgarly called, the chalybeate, in particular. Moſt men ſee their powerful effects, in the moſt inveterate, deſperate caſes; and therefore, when moſt practicioners find the ordinary ſhop medicines ineffectual, if not hurtful; the patient is ſent to ſome mineral water, rarely with any particular choice or direction. Aſk with what intent? and, if any cauſe be aſſigned, it will, for the moſt part be found, that the good effects, expected from the waters, are aſcribed to that, which bears the ſmalleſt, if any, ſhare in their curative qualities.

§ 478. Agreeable to this, we find ſome of the beſt writers on medicated waters giving an accurate account of the minerals, through which the water paſſes; nicely enumerating their qualities and virtues; then, calculating how much of this or the other ſolid matter, a given quantity of the water contains, and attributing to this or that, the extraordinary virtues of the water; when the moſt active and efficacious ingredient has been, for the moſt part, quite overlooked.

§ 479. I mean not to diſcommend or diſcourage enquiries of this nature: They are always neceſſary. They have their uſes. The heavieſt mineral body, that meets a fit ſolvent in the bowels of the earth, is capable of imparting ſenſible, active qualities to any water paſſing that way. And thoſe, that are charged moſt copiouſly with ſuch ſubtil matter, as is the real cauſe of the chief energy of mineral waters, though it commonly eſcapes obſervation, are liable to remarkable alterations from the groſſer impregnations, with which they happen to be combined.

§ 480.

§ 480. The caution, I would inculcate, is, that when the ſolid contents of a mineral water are, by due experiments, learned; that the virtues of the water may not be aſcribed to ſuch things, as may be taken by themſelves, in ten times a greater doſe, at once, than any quantity, ordinarily given of the impregnated water, in the compaſs of ſome days, can be ſuppoſed to contain.

§ 481. In order to make a juſt and rational eſtimate of the virtues of any compound, let the component parts be firſt ſeparated; the proportions determined, the nature and properties of each ingredient aſcertained, and the reſult of the union may be eaſily judged by every one, but moderately converſant with the laws of nature, in the animal oeconomy, and in the operation of medicines.

§ 482. Hitherto, the efficacy of theſe, as well as of moſt other waters, has, by moſt writers, been hardily attributed to their ſolid contents, and theſe but ſuperficially examined. Moſt have contented themſelves with turning ſirup of violets green, which they aſcribed to an alcali. Some obſerved, their ſtriking onely a blew with that ſirup; having viewed it at the inſtant of time, in which that color is produced, without any regard to the preceding or conſequent changes. Others, layed their whole ſtreſs upon finding the waters tinging purple with galls. This was in general pronounced to be iron, or martial vitriol, and this of a ſingular kind, volatile vitriol; an error, of which even the great HOFFMAN was not able to keep clear: For, he ſpeaks of two kinds of that concrete, the one fixed, the other volatile. But, how improperly, has already been pointed out [a].

§ 483. In order to judge aright of the nature and qualities of the preceding waters; let us take a brief recapitulating view of their component parts, as they appear upon our analyſes. And, theſe explaned, let us

[a] In various places; particularly, Of mineral waters in general, § 61.

procede to compare theory and practice together, and confirm or correct the one by the other.

1. After the elementary fluid in the waters, too palpable to the ſenſes, to require further arguments for it's illuſtration; ſince hence, they juſtly take their denomination; the firſt and great impregnation is with that moſt ſubtil, volatile fluid, which, of all known beings, beſt deſerves the name of a ſpirit: I mean that exquiſitely fine, fleeting eſſence, ſo often ſpoke of before, particularly in the introduction to the ſecond part of this Eſſay [a], and demonſtrated more or leſs in each of theſe waters, with an elaſtic air or aether; 1. in their ſparkling in their ſources, as well as upon being removed from them; which can onely ariſe from the eſcaping of ſuch ſubtil fluids. 2. In leaving the water flat and vapid, as well as turbid, and further decompoſed upon it's eſcaping, in the open air or otherwiſe [b]. 3. In the roſe purple, crimſon or red caſt, given the firup of violets at firſt mixture, with the perfect water; which is not ſeen with the imperfect, or the water by any means ſpoiled of this ſpirit [c]. 4. In the not ſtriking their dye ſo ſoon with galls, as when ſomewhat ſpoiled of this ſpirit [d]. 5. In the ſolution they make of the filings of iron [e]. 6. In the union with alcalies, with a ſlight commotion, with the volatile, and none with the fixed, in a liquid form [f]. 7. In the commotion, which it occaſions with acids, while in the natural ſtate; and none, when ſpoiled [g]. 8. Upon the addition of metallic ſolutions [h]. 9. And laſtly, in the various phaenomena upon deſtillation, as well as by the products of the operation [i]. By which this appears, not onely a moſt exalted, ſubtil, volatile, but an acid ſpirit. And, with this, all the waters, as well as this firſt inſtance, are more or leſs charged. See the comparative analyſis of each.

[a] § 29. 1. [b] § 92. to 96. [c] § 97. 1. 2. § 98. 1. 2. [d] § 100. 1. 2. 3. 4. [e] § 103 104. 105. 1. 2. 3. 4. 5. [f] § 106. 107. 108 [g] § 110. 111. 112. 1. 2. [h] § 115, to § 122. [i] § 124 to 126.

2 The

2. The part, which firſt ſhews itſelf upon our trials, ſuſpended in the waters, by the means of this ſpirit, both probably iſſuing from the ſame ſource, is the iron; which no longer ſubſiſts in a ſtate of ſolution, after this ſpirit has deſerted the waters, or they have been further ſaturated, with abſorbent earths or alcalies. The preſence of iron is ſhewn, 1. by the ochrous ſediment, depoſited by the waters in their courſes, or upon ſtanding any way to loſe their volatile eſſence [a]. 2. By the firſt green tinge to the ſirup of violets [b], with corn blew bottle [c]. 3. By the crimſon, purple or blew dyes, ſtruck with any aſtringent vegetables; with the infuſion of galls particularly [d]. 4. By the yellow hue, given by volatile and fixed alcalies [e]. 5. By the purple tinging quality, when loſſed, being reſtored by the vitriolic acid [f]. 6. By the pale brown precipitate, lying over that of lead [g]. 7. By the diverſicolored pellicule, it throws up, upon being by any means decompoſed, particularly in heating, as in the deſtillation; and by the muddy color, it contracts, and the ochrous depoſite, it makes in that operation [h]; which being ſeparated from the liquor, ſtands every teſt of iron [i].

§ 484. By our experiments, the proportion of this martial earth is,

1. In the Pouhon, to the water, twenty granes, to twenty pints; that is, one grane to the pint; to the other ſolid ingredients, as one to two [k].

2. In the GROISBEECK, ſeven granes, to twenty pints, not one third of a grane to the pint; to the other ſolid parts, as ſeven, to eleven [l].

3. In the SAUVENIERE, ſix granes and an half, to twenty pints of water, leſs than one third of a grane to the pint; to the other fixed contents, as ſix and an half, to eleven and an half [m].

[a] § 92. 4. to § 108. [b] § 97. 1. 2. [c] § 98. [d] § 100. [e] § 106. [f] § 106 5. [g] § 120. [h] § 124. [i] § 127. 1. 2. 3 4. [k] § 127. 128. 129. [l] § 163. 164. [m] § 192. 193.

4. In

4. In the WATROZ, eight granes to twenty pints; above one third of a grane to the pint; to the other ſolid ingredients, as eight, to twelve [a].

5. In the GERONSTER, ten granes to twenty pints; half a grane of martial earth to the pint; to the other ſolid parts, as one, to two [b].

6. In the TONNELET, ten granes in twenty pints, one half of the ſolid contents; half a grane to the pint [c].

7. In the SART, above ten granes in twenty pints, to above nine of the other ſolid parts; which is above half a grane of martial earth to the pint [d].

8. In the CHEVRON, above thirteen granes in twenty pints; to about twenty two granes of other ſolid contents; above half a grane and half a quarter to the pint [e].

9. In LA SIGE, there are not probably above one grane and a quarter in twenty pints, to one hundred and fivety eight granes and three quarters of other ſolid parts [f].

10. In the GEROMONT, the proportions are nearly the ſame, as in LA SIGE, about one grane and a quarter of martial earth, to one hundred and fivety eight granes and three quarters of other fixed contents [g].

11. In the TUNBRIDGE, about fiveteen granes in twenty pints, to about ſixty granes of other ſolid parts [h]; three quarters of a grane to the pint of water.

12. The other ſolid parts contained in the waters are two-fold; a non-metalic earth, which is two-fold; calcarious and ſelenite, and a mineral alcaline ſalt.

§ 485. The firſt, or non-metallic, as well as the metallic, parts are demonſtrated, 1. by the precipitations, with volatile and fixed alcalies [i]. 2. Partly by the precipitations with the metallic ſolutions, which alſo indicate the ſaline parts [k]. 3. In part by the ſirup of violets, and juice of blew-bottle; which argues

[a] § 222 223. [b] § 258. 259. [c] § 295. 296. [d] § 329. 330. [e] § 364. 365. [f] § 399. 400. [g] § 427. 428. [h] § 470. 471. [i] § 106. 107. 108. [k] § 115. to § 122.

alſo the preſence of the metallic earth, as well as of the alcaline ſalt [a]. 4. By evaporation, to about the loſs of one eighth, when the ſelenite appears in light, bright flakes aflote [b]. 5. By evaporation to a dryneſs, when the whole agregate of earth and ſalts appear, with the oily matter, from which, no water is free [c].

§ 486. The non-metallic earth appears to be twofold; calcarious and ſelenite, by it's being partly ſoluble in the acid of ſea ſalt, and giving lime by calcination; and by being partly inſoluble in all acids, and unchangeable by fire [d].

§ 487. The proportions of theſe earths in each water are as follow;

1. In the POUHON, twenty two granes in twenty pints, above a grane to the pint, of which about thirteen granes are calcarious earth; the reſt, ſelenite [e].

2. In the GROISBEECK, ſeven granes in twenty pints; whereof, above four granes are calcarious, the reſt, ſelenite [f].

3. In the SAUVENIERE, ſix granes and an half; whereof, about four parts are calcarious earth, the reſt, ſelenite [g].

4. In the WATROZ, ſix granes in twenty pints; whereof, about three granes and an half are calcarious earth; the reſt, ſelenite [h].

5. In the GERONSTER, fourteen granes in twenty pints; whereof, near nine granes are calcarious; the reſt, ſelenite [i].

6. In the TONNELET, five granes in twenty pints; whereof, above three granes are calcarious earth; the reſt, ſelenite [k].

7. In the SART, about ſixteen granes, in twenty pints; whereof, about one half is ſelenite, the other, calcarious earth [l].

8. In the CHEVRON, twenty granes, in twenty pints;

[a] § 97. 98. [b] § 129. 1. [c] § 130. 131. [d] § 134. 135.
[e] § 134. 135. [f] § 167. [g] § 194. [h] § 227. [i] § 263.
[k] § 300. [l] § 334.

whereof,

whereof, above half is a calcarious earth, the reſt, ſelenite. § 366.

9. In LA SIGE, about one hundred and thirty eight granes and three quarters, in twenty pints; whereof, one hundred and eight granes are calcarious earth, and about thirty granes and a quarter, ſelenite; deducting one grane and a quarter of martial earth from the product of § 403, 404.

10. In the GEROMONT, about ninety granes and a quarter in twenty pints; whereof, ſeventy four granes are calcarious earth; the reſt, ſixteen granes, ſelenite [a].

11. In the TUNBRIDGE, thirty granes in twenty pints; partly calcarious and partly ſelenite [b].

§ 488. The fourth of the component parts of theſe waters are the ſalts. Theſe appear, 1. In expediting the decompoſition of the water as it ſtands [c]. 2. In the deepeſt green with the ſirup of violets, and juice of blew bottle [d]. 3. In ſome meaſure, in the precipitations of all the metallic ſolutions [e]. But, 4. and chiefly, upon evaporating to a dryneſs [f].

§ 489. The proportions of this ſalt, extracted from the ſeveral waters are as follow;

1. From twenty pints of the POUHON, eighteen granes [g].

2. From twenty pints of the GROISBEECK, four granes [h].

3. From twenty pints of the SAUVENIERE, five granes [i].

4. From twenty pints of the WATROZ, ſix granes [k].

5. From twenty pints of the GERONSTER, ſix granes [l].

6. From twenty pints of the TONNELET, five granes [m].

7. From twenty pints of the SART, above three granes [n].

[a] § 431. [b] § 473. 475. [c] § 92. 1. 2. 3. 4. [d] § 97. 98. 1. 2. [e] from § 115, to 122. [f] § 128. 7. § 130. 131. [g] § 131. [h] § 166. [i] § 194. [k] § 226. [l] 262. [m] § 299. [n] § 333.

8. From twenty pints of the CHEVRON, two granes [a].

9. From twenty pints of LA SIGE, twenty granes [b].

10. From twenty pints of the GEROMONT, ſixty eight granes [c].

11. From twenty pints of the TUNBRIDGE, about thirty granes, quite different from all the reſt [d].

§ 490. An other ingredient in this water, which is not to be omitted in a juſt analyſis, or eſtimate of the nature and qualities of the compoſition, is the oily matter. This, it is true, is more or leſs common to all the waters, that have hitherto fallen under my cogniſance; whether meteoric or terreſtrial, ſimple or medicated. No man therefore, can be ſayed to explane the conſtituents of any water, without diſcovering this body. Theſe waters have a conſiderable ſhare of it. It is from this, the waſhings of their earthy reſidua, and their ſalts, derive their colors. And to theſe, the ſharp ſtench, upon putrefaction, ariſes; whence, in waters highly putrid, none of this ſubſtance is diſcovered.

§ 491. The proportion of this oily matter is not eaſily aſcertained in any water; but, leſt of all in ſuch as contain a ſubtil, volatile acid, which partly adheres to their alcaline ſalt. If the ſolid contents, obtained by evaporating a given quantity of any of theſe waters, for example, to a dryneſs, be thrown into a ſmall, weighed crucible, well ignited; ſome ſubtil vapor, manifeſted by the ſmall, and ſome viſible fume, more or leſs, will fly off; and, if it be continued heated, till theſe ceaſe; then, taken out and weighed; it will be found to have ſenſibly amitted of it's weight, which is eaſily determined by the balance.

§ 492. This might give us the exact quantity of oily matter in the reſiduum taken, or the water, whence it was extracted; could we be aſſured, that nothing elſe, was at the ſame time loſſed. But, a portion of

[a] § 368. [b] § 402. [c] § 430. [d] 474.

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the ſubtil, mineral acid, adherent to the alcaline ſalt, always flies off at the ſame time, or before it; which leaves this in great uncertainty.

§ 493. It may alſo be extracted from the ſalt, by alcohol, to which it gives a yellow tinge. But, here we are expoſed to the ſame incertainty: For, there is no preventing ſome portion of the alcaline ſalt's being abſorbed by the moſt perfect alcohol, that art can prepare: So that we muſt, till a better method be diſcovered, ſit down contented with ſhewing the exiſtence, without being able, with deſireable accuracy, to aſcertain the quantity, of this oily matter in theſe, and theſe like waters.

§ 494. The ſeveral ingredients of theſe exquiſite eſſences, being thus demonſtrated to conſiſt, 1. of a moſt exalted, ſubtil, volatile fluid; with 2. a conſiderable portion of moſt fine, elaſtic air; 3. of a martial earth, or iron ſpoiled by ſolution, or otherwiſe of it's phlogiſton and metalliſing principle; 4. of earth, partly abſorbent or calcarious, partly ſelenite; 5. of alcaline ſalt, and ſome, as thoſe of Malmendy, of a ſmall portion, or as that of Tunbridge, chiefly conſiſts, of muriatic ſalt; 6. of ſome portion of the oily matter, inherent to all water; and 7. of the great baſis of all fluids, the aqueous element; all moſt intimately blended, as they are wonderfully produced, by the inimitable Chemiſtry of Parent Nature.

§ 495. Let us next ſee what effects the compound produces, and to what theſe effects are to be juſtly attributed. 1. All theſe German waters inſtantly kill the little fiſhes of the neighbouring rivulets, upon being thrown into them, and that, in a manner ſo ſingular, as to merit a more particular deſcription. One of the ſmall fiſhes, thrown into a large baſon of the Pouhon water, flies about with incredible force and velocity, and ſometimes, gets out of the water. This violent ſtruggling continues a few ſeconds; when, the animal falls into convulſions, loſes his poiſe, turns up his belly, gaſps, and apparently dies, or lyes inſenſible and motionleſs. All this happens in about half

a minute. If the creature be then taken out, let to lye in the open air, ſix or eight ſeconds, and then be thrown into clean, ſweet water; in four or five minutes, it recovers life, ſenſe and motion perfectly. If it be not firſt expoſed ſome ſeconds to the action of the air; it takes double the time to recover, upon being thrown immediately into the freſh water. And, if it be permitted to lye but two minutes in the mineral water; none other water or air is able to recover it. All the other waters have the ſame effect, quicker or ſlower, according as they are more or leſs ſpirituous. Thus, the fountanes of Tonnelet, Brue, Geromont, La Sige, Couve, Sart, produce this effect in little more than half the time, in which it is wrought in the Pouhon, and it is ſtill ſlower in the reſt.

§ 496. This can be attributed to no part of the impregnation, but the ſpirit and the air. This appears proved by theſe two conſiderations: 1. The waters, that are found the leſt charged with theſe volatile parts, are the ſloweſt in producing theſe extraordinary effects; while the ſtrongeſt are obſerved to produce them the ſooneſt. Moreover, 2. when any of theſe waters are, by lying expoſed, or by agitation, ſpoiled of their volatile parts; theſe fiſhes can inhabit them, without theſe violent emotions, or ſudden death. Whence, we may reaſonably conclude, it is the ſubtil air and volatile ſpirit in the waters, that prove noxious to the natural inhabitants of the watery element.

§ 497. 2. No part of the brute creation willingly drinks of theſe waters: Forbidden, perhaps, by their ſtrange taſte, or diſagreeable effects, or both. But, taken by man, they have quite different and moſt pleaſing effects. The taſte, for the moſt part, proves grateful; and their operation proves generally ſo, in a ſtill higher degree. 1. At firſt taking, they ſeem cool, and pleaſingly to ſlake thirſt. But, 2. ſoon after taking, they are found warm, and to ſome, heating. 3. They alſo raiſe the ſpirits to the utmoſt chearfulneſs, and a vivacity, with ſome degree of inebriation or in-

intoxication. And, 4. more ſuddenly work this effect, than the moſt ſpirituous, artificial liquor known; for, it appears within the compaſs of a few minutes after drinking them quickly, to the quantity of about a pint, or leſs, with ſuch as are not accuſtomed to them; and the effects as ſuddenly vaniſh, as they came on, or more ſo; giving a general tranquility, and leaving, with moſt, ſome propenſity to ſleep; eſpecially after the next meal.

§ 498. Thus we ſee, ſomething inconceivably fine and ſubtil eſcapes from this water, and by pervading the pores of the bowels, works itſelf a more ſpeedy paſſage to the grand ſenſory, than can be imagined by the ordinary rules of digeſtion, ſecretion and circulation, and makes this remarkably quick and tranſitory impreſſion upon the brain and nerves. Is this to be aſcribed to any of the ſolid contents of the water? Can the iron, on which, moſt reſt the virtue of theſe waters, work this change? Is it to be imputed to the other earths, or the fixed ſalts of the waters? Or, to all conjointly?—No certainly; becauſe, a greater proportion of any, or all, of the ſolid contents united, than are found in any quantity, of theſe waters, that may be taken properly within the compaſs of one, or even of two natural days, can poſſibly produce effects in any ſort analogous to thoſe, wrought by a pint of the pure, perfect water, within the compaſs of ten or fiveteen minutes.

§ 499. All ſolid matters, capable of ſolution, are, it is true, diviſible to moſt extreme tenuity. The earths, ſuſpended in the waters, and eſpecially the iron, are ſuch. And, in this ſubtil ſtate of diviſion, can act more powerfully, as well as more ſpeedily, beyond compariſon, than they can in any agregate ſtate, in which they can be given. In this ſtate of ſolution, while they remane in it, they may be ſuppoſed to act like ſalts, by the form and ſize of the molecules, into which they are divided, and their ſpecific gravi-

ties, by which they give a weight to the fluids and elaſticity to the ſolids.

§ 500. But, giving theſe like matters, the quickeſt determination, that the known laws of nature, and the animal oeconomy will admit; it is impoſſible, they ſhould, in the time, that the water acts, or indeed in any time, produce effects, in any degree, analogous, in time or quality, to thoſe, wrought by the water.

§ 501. For, could the water carry all it's ſolid contents beyond the firſt paſſages, into the ſecond digeſtion, unaltered in quality or quantity; by their known properties, and the laws of the oeconomy, they could produce none other effects than thoſe lately enumerated, and that, but very ſlowly, compared to the ſudden effects of the waters found in § 497. 1. 2. 3.

§ 502. But, when taken in the agregate ſtate, it is impoſſible, that all ſhould paſs the exquiſitely fine ſtrainers of the lacteal glands, and enter the blood. Wherefore effects ſtill different muſt be more ſlowly wrought.

§ 503. We ſee what happens, when the water is deſtilled, or ſtands but open in a warm air, or is briſkly agitated; ſomething very ſubtil and volatile is loſſed; the water grows vapid and muddy; and in time, one of the earthy parts, to wit, the metallic, is ſeparated, and ſubſides. If the exhalation be further continued, the other earthy parts attract each other, and uniting, form ſhining, minute, thin, lamellae, which are chiefly ſelenite.

§ 504. A decompoſition, not unlike this, happens in the animal oeconomy, partly in the firſt, partly in the ſecond paſſages: No ſooner is the newly drank water received into the ſtomach, than it is warmed and agitated by the heat and motion of that, and the other bowels: By which, the volatile parts muſt be ſet in motion. And they are ſo: As appears, 1. by their manifeſting their quick, ſpirituous effects in hot,

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piquant belchings from the ſtomach [a]; 2. by their ſuddenly ſubſequent inebriating quality [b]. Thus then, the ſubtil ſolvent of the iron, muſt in a great meaſure eſcape, and produce theſe laſt recited effects, before the iron can, in any ſhape, have paſſed the ſtomach. It muſt then be left there, if not abſolutely diſſolved, at leſt in a very ſubtil ſtate of diviſion; ſuch as probably renders the gaſtric juice capable of making another complete, though partial, ſolution of it. I ſay partial; becauſe I can have no doubt of a large portion of it being precipitated; when I ſee the gums, teeth, and tongue died black, as well as the alvine feces; which can by no conceivable means ariſe, but by the precipitation of ſome portion of this metal. But, be that as it may, it is evident, that the iron is neither in quantity nor of quality capable of producing the quick exhilarating effects of the newly drank water.

§ 505. As to the other terrene parts, their action might poſſibly have been confined to the firſt paſſages, had they not been taken in a ſtate of ſolution. The calcarious earth might, it is true, in ſome meaſure, be diſſolved in the gaſtric juice, fine enough, perhaps, to paſs the ſtrainers of the inteſtines and meſentery. But, the ſelenite muſt undoubtedly have remaned unaltered, till rejected. However they may be diſpoſed of in the oeconomy; it is evident, their action muſt be but ſlow, and therefore no part of the quick, inſpiriting action of the water newly drank, is to be aſcribed to ſuch inactive matter.

§ 506. In general, theſe earths, with the ochrous, combine in abſorbing and coſtipating the bowels: For, moſt drinkers of theſe waters are more or leſs ſubject to a coſtive ſtate.

§ 507. One moſt untowardly effect, I have obſerved at Spa, which I can attribute to nothing elſe, but the terrene, non-metallic parts of the waters, that of the Pouhon in particular: I mean the Tumidum

[a] § 268. [b] § 497.

Gut-

Guttur of the poets, the Goitre, of the French, known to phyſicians by the name of Bronchocele; a rupture or rather a preternatural tumor of the Thyroide gland; an evil much complained of at the feet of the Alpes and Pyrenees, but falſely imputed to the drinking of ſnow water: Since, wherever hard, terrene waters are much drank, this unſeemly ſight is always rife. I have ſeen many old paiſants of both ſexes in Rheims, loaded with this over-grown gland, to an enormous ſize. And, in the village of Spa, where the Pouhon water is the poor's chief beverage, I have obſerved numbers of old people, eſpecially women, with gorges tumified like cropper-pigeons. While I was there, I was conſulted by ſeveral Germans, Dutch and French, as well as Engliſh; in whom, I found ſuch a tumor forming. Theſe were perſons, who had drank exceſſively of this water for ſeveral ſucceſſive ſeaſons.

§ 508. With me, it is no way difficult to conceive how waters, charged with earthy matters, particularly the ſelenite, ſhould, whenever the ſubtil ſolvent of theſe matters is loſſed or changed, ſuffer a ſeparation, and by attraction, aggrandiſe the late ſuſpended particules, till they by degrees grow too large to paſs the moſt minute, fine ſtrainers of the glands, and there, form ſuch obſtructions, as neceſſarily produce thoſe or ſuch like preternatural ſwellings. Why this particular gland ſhould be moſt ſubject to this kind of tumor, and that in women, rather than men, requires a deeper diſquiſition, than this place and preſent circumſtance can admit. Upon the whole, this, as well as the preceding terrene parts of the water, muſt not be ſuſpected of any effect, like the exhilarating quality of the water.

§ 509. Shall we then, look for this effect from the ſalt; for, this is confeſſedly more active than either of the earths can poſſibly be?—The utmoſt, that twenty pints of the Pouhon afford of this ſalt, does not excede eighteen granes. And a man may take more than double that quantity, of any lixivial ſalt, even

the pureſt, without any ſuch ſenſation, as a pint of the water, in a few minutes after it is taken, gives. This lixivial ſalt may diſſolve fat or greaſe, reſolve mucous congeſtions, and thereby break calculous concretions; may in general, diſſolve viſcid coheſions or coagulations, thin the juices, irritate the fibres of the veſſels, to promote the propulſion or diſcharge of their contents; hence, ſuch may, in larger quantities, purge, in ſmaller, excite a diſcharge by ſweat or urine; effects, which experience proves. But, if the largeſt doſe of theſe like ſalts, can produce none effect, like that of the recently drank water; what are we to expect from the ſmall pittance, not equal to a grane, in the pint of water?

§ 510. We can no more place this quality in the oily matter, than in the ſolid contents; ſince this is common to other waters, from which, no ſuch effect is found.

§ 511. Thus have we examined the ſolid contents of theſe waters, jointly and ſeverally, and can find, that, from no conjunction of them, and much leſs from individuals, are we to expect any of the effects, produced by the recently drank water.

§ 512. Yea more; art is capable of bringing about very perfect ſolutions of theſe ſolid ingredients, and diluting them, to any pitch, with pure water. And yet then, can they not be found to anſwer any of the purpoſes of the perfect, natural water. Could this artificial water ſuccede, the natural would be leſs valuable. But, it onely ſerves to ſhew us the extreme diſparity between the operations of nature, and thoſe of art: Since, we find the natural waters contain ſomething, that art has hitherto been utterly unable to emulate.—Hence, all attempts hitherto made to counterfeit theſe waters, have proved groſsly ridiculous.

§ 513. This is the moſt active, ſubtil, volatile ſpirit, of which we have before made mention [a]; not

[a] Introd. § 29. 1. and following.

ineptly

ineptly looked upon as the life or ſpirit of all active mineral waters, and that, on which, their chief energy, their greateſt efficacy depends: For, whatſoever waters are found clear of noxious matter, and fully impregnated with this moſt powerful eſſence, muſt be found to correſpond in medicinal virtues. This alone is able to warm, to cheriſh, to exhilarate, and invigorate; to recover loſſed appetite; to eſtabliſh a good digeſtion; to reſtore due fluidity, and to promote a perfect circulation of the fluids, and to confirm all the natural ſecretions. No material ſubſtance known can be ſo capable of pervading the moſt remote receſſes of the human frame, as this moſt ſubtil, penetrating ſpirit. No wonder then, we find, from daily experience, that nothing equals this inimitable eſſence in invigorating relaxed fibres; in reſtoring their due tone and elaſticity; and, in prompting them to exert their natural functions; ſo as to remove all manner of obſtructions, that are not attended with inflammation; beyond any thing elſe, that has as yet fallen within the reach of human underſtanding. From this then, the languid, pale virgin, may expect cheerful ſpirits, and a vigorous complexion. The cold melancholic and leucophlegmatic, the univerſally obſtructed, deſperate hypochondriac and diſtreſſed hyſteric, and the enervated paralytic may reaſonably look for, and muſt generally find, relief, from a moſt ſubtil, penetrating, active fluid, capable moſt quickly to inſinuate itſelf through the fineſt, minuteſt canals and pores of the human frame, and while it attenuates and mends the ſtate of the juices, gives the ſolids ability, and excites them to exert their natural functions.

§ 514. Hence, it is eaſier to conceive, than enumerate, the almoſt endleſs variety of chronic diſeaſes, immoveable by all other known remedies, which muſt effectually give way to the matchleſs energy of this hitherto inſcrutable ſecret of unerring nature; which is lodged plentifully in theſe moſt excellent waters. And if this active ſpirit be, as I conceive it muſt be found

found, the cauſe of their chief energy; that water, in which this ſpirit moſt abounds, muſt certainly be the beſt.

§ 515. I do not deny the ſolid parts of the water their ſalutary qualities, particularly the metal and the ſalt. They may, and in many caſes certainly do, moſt powerfully ſecond the tonic and deobſtruent virtues of the mineral ſpirit. Therefore, they are always, and their operations, undoubtedly to be taken into the eſtimate. I mean onely to ſhew, what I conceive, that they are but ſecondary agents; and that the ſpirit of the waters produces it's quick effects, before the mere element, or the fixed terrene or ſaline parts, with which it is charged, can in the ordinary courſe of the oeconomy, enter into the ſecond digeſtion.

§ 516. The practicioner is therefore to conſider the effects, theſe like waters produce, in the firſt and ſecond inſtances, and then judge which is moſt for his purpoſe. Thoſe, that appear moſt charged with any thing, but ſelenite, unqueſtionably have their uſes in a variety of caſes; but in general, it is not to be diſputed, that that water, which is moſt fully fraught with this volatile eſſence, and contains leſt of any parts, but the metallic; muſt, of all others, be the moſt powerful, the moſt excellent, the neareſt the univerſal, remedy.

§ 517. But, where the bowels are in a very lax ſtate, and overcharged with acid humors; there, the more terrene, the metallic and the calcarious eſpecially, muſt moſt effectually ſecond the intentions of the more active parts, in abſorbing humidity, blunting acidity, and bracing up the tone of the flaccid fibres, of the firſt paſſages, if not in ſome meaſure of the ſecond.

§ 518. Theſe waters then, muſt prove moſt powerful remedies in a variety of caſes, beyond the reach of artificial preparations; in a languid, depauperated and broken ſtate of the juices, with a conſequent relaxa-

tion

tion and general imbecility of the ſolids, the conſequences of exceſſes and debauchery, luxury, ſoftneſs and inaction, or the effects of a ſedentary, ſtudious life, or the attendants of rebellious chronic or long and violent acute diſeaſes; nothing brings ſo effectual, ſo ſpeedy relief, as theſe ſpirituous waters. In thoſe foulneſſes of the firſt paſſages, that occaſion the engendering of worms, of all kinds, with all their long train of ills; in thoſe viſcid ſtates of the juices, that cauſe obſtructions of the natural diſcharges, or of the ſecretions, in the womb, meſentery, ſpleen, liver, and the pores univerſally; ſuch as lay foundations for hyſteric and hypochondriac affections, for melancholy, jaundice, ſcirrhus, calculous concretions in general, gouts, rhumatiſms; and even for diſorders, whoſe ſeats and ſprings are more remote; lethargies, epilepſies, apoplexies, palſies, and the long catalogue of nervous diſtempers, that imbitter human life; in thoſe relaxations, that cauſe unnatural diſcharges in the ſex eſpecially, and imbecility and ſterility in both ſexes; in many cold, ſluggiſh conſtitutions, attended with aſthma and pthiſic, ariſing from a relaxed ſtate of the ſolids and an influx of groſs, heavy viſcid phlegm, upon the lungs and glands about the organs of reſpiration and ſpeech; in ſhort, in all kinds of obſtructions and defluxions, void of inflammation or tendency thereto, and in many conſumptive caſes, in conſtitutions of this claſs; no remedy has yet been known comparable to theſe mineral waters. And their primary efficacy, to me, appears owing to their unparalleled volatile parts; their ſecundary, onely to the terrene parts, with the aqueous element, that dilutes the whole.

§ 519. Upon the analyſis and the principles layed down, the choice of theſe waters is to be founded. Where the great ſtreſs is to be layed on the action of the volatile parts, as in the moſt cold, ſluggiſh, nervous affections and obſtructions; the moſt ſpirituous and active, the lighteſt and leſt terrene waters are moſt proper.

proper. On the other hand, where the action of iron or abſorbents are ſought, as in redundant humidity and acidity, the more charged, heavy and leſs ſpirituous waters will be the more ſuitable.

§ 520. Let no man be deceived by the idle preference given one water to an other, by the writers and practicioners of Spa, on account of it's containing ſulphur, which they think fit, to call volatile, and thence pronounce the water pectoral. Or, by their notions, or even Certificates of this ſulphureous eſſence in the water's being ſo volatile, as to be found, in perfection onely in the upper part of a glaſs or flaſk, and of it's being loſſed in the carriage from the ſpring to the village.

§ 521. This volatile ſpirit in theſe and all ſuch like waters, in my judgement, is none other, than the univerſal acid, ſubtiliſed and volatiliſed by ſome portion of inherent phlogiſton, both ariſing from the decompoſition of Pyrites in the bowels of the earth. Of the later, it is true, ſome may and have enough to give a ſenſible ſmell; but hardly enough to give any other proof of ſuch an impregnation; as the Geronſter. But, by no means enough to ſhew any ſigns of real ſulphur. Moreover, this volatiliſed eſſence is certainly ſo ſubtil, ſo active, as never to be at reſt, and ſo penetrating as to be very hardly confined. But, ſo far from the upper part of a glaſs of it being the beſt, that by reaſon and all the preceding experiments upon the water in open glaſſes, the ſurface expoſed to the air, which is the uppermoſt, always appears to be the firſt ſpoiled: For, where volatile ſpirits meet the leſt reſiſtance, thither will they certainly fly. The ſurface then, of this or any other volatile liquor, expoſed to the open air, muſt ſuffer moſt loſs of it's active parts.

§ 522. But, ſuppoſe it otherwiſe, that the volatile ſpirits, like oil on water, continually riſe to the top, or are more collected in the upper ſurface, than in any other part of the fluid; why is one glaſs or two onely of a flaſk to be taken, as containing the ſpirit

of

of the whole, rendering the reſt quite vapid and uſeleſs, as ſome aſſert?—This muſt appear quite ridiculous, when, from the poſition, in which the flaſk is to be placed to empty it, not the mouth, but the bottom, muſt be uppermoſt; which, with the incourſe of air, neceſſary upon the running out of the water; muſt have carried back this volatile eſſence, had it been before actually uppermoſt in the neck of the flaſk. The fact is, a flaſk, as ſoon as a glaſs is drawn out of it, begins inſtantly to loſe all, that the reſt of the water holds volatile, and becomes in a ſhort time quite effete and vapid. But, let it be poured out as quick as may be, into ſeveral glaſſes, I affirm from reaſon and experience, the laſt glaſs will be equal to the firſt.

§ 523. Then, as to it's not bearing carriage from the ſpring to the village; I affirm the contrary: For, I always repeted thoſe experiments, I had made at the reſpective fountanes, after my return to Spa, and could never obſerve any meaſurable difference. Yea more, I brought of all the waters, here examined, into Britain; and found them; even thoſe reputed the moſt volatile, in as great perfection, as thoſe deemed the leſt volatile; that is, ſuffering none other change, than what that volatile ſpirit and air long included and confined in a bottle muſt undergo; which is growing more active, ſmart, and fugitive, as moſt fermented liquors bottled uſually do. And the Tunbridge water, as taken up according to my directions, and ſent to me to London in cold weather, ſuffers no ſenſible change; except ſomething leſs of air upon pouring into a glaſs: For, it tinged as deeply and as ſoon with galls, and anſwered all the other experiments, as at the fountane.

§ 524. However, I do not mean from this, to recommend the drinking theſe, or indeed any medicated waters, remote from the ſpring: For, the nearer the ſource, the more natural the ſtate, the higher the perfection, in which they muſt always be obtained; for reaſons, too obvious, to be enumerated, to the attentive, intelligent reader.

Of

Of the Seaſons and Manner of drinking theſe WATERS.

§ 525. THE climate, ſoil and nature of the waters of Spa, &c. being explaned, and the diſorders, for which they are found effectual and proper, pointed out; we are next to conſider the fit ſeaſons and manner of applying them, to ſerve theſe purpoſes; and firſt, of the ſeaſons.

§ 526. 1. Although it has been ſhewn, that the waters are in the higheſt perfection in cold weather; yet, is not this the fit time for taking them: For, beſides the difficulties, with which ſtrangers muſt be attended in going thither, as well as living in a cold, dreary, mountanous country in the winter; the water itſelf muſt be intollerably cold to the mouth, throat and ſtomach; ſo that it might chill the drinker, before it's ſpirituous parts could come into action. And beſides, by the conſtriction of the pores, from the external air; one of the principal operations of the water, it's promoting tranſpiration, muſt be counteracted, if not quite impeded, and a diſcharge by urine too ſuddenly and too copiouſly precipitated; effects ſeldom deſireable, and often deſtructive.

§ 527. On the other hand, exceſſive heat is the oppoſite extreme, and equally deſtructive in another manner. The waters are then quicker in their operation, and too apt to increaſe the heat of the body, from the natural, to the preternatural ſtate. But, againſt this evil, nature makes ſome proviſion; by weakening the waters, in proportion to the heat they may undergo: For, whereas in cold, dry, froſty weather, the ſpirits are ſo concentrated, as to render the water extremely ſtrong; ſo, as the air gets warmth, it ſenſibly rarifies, and of courſe diſpels theſe ſpirits. Theſe changes however, are leſs ſenſible in the quick, than in the ſlow ſources. Hence, the Tonnelet and the Chevron leſt feel the extremes of weather, from the velocity of the motions of their ſprings.

§ 528. The extremes of cold and heat, appearing equally improper, though from different cauſes; the mediocrity between them gives us the fit ſeaſons for drinking theſe waters. Theſe are from the beginning of May, till the middle, and often the later end, of October. Some of the intermediate months, it is true, are far from temperate; for, at ſome times, in July and Auguſt, the heat in the mountanes, in this part of Germany, is intollerable, without doors. But, this is but rarely the caſe; and ſuch heat is ſeldom of long duration. This inconvenience may be better evaded, than that of wet weather, which is the moſt frequent about Spa.

§ 529. With care and diligence, the water may be had in ſufficient perfection, at certain hours, in the hotteſt weather known. Thus, it is to be had, any morning before the ſun gets enough, above the horizon to warm the atmoſphere. In July and Auguſt, it will be cool enough, from five of the clock in the morning, to ſix or ſeven; in the other months, from ſix to eight, or later. And, however altered the waters may be by the heat of the air, by which, by the by, the Tonnelet and Bru are but little affected; it will be proper, in many caſes, to take a glaſs or two about noon, as well as in the evening.

§ 530. But, different ſeaſons ſuit different temperaments. The weakly and chilly, that are not able to warm themſelves by fit exerciſe, ſhould rather take the waters, when the air is warmer, by a fire's ſide, in warm bed, and in ſome caſes, in a warm bath. Thoſe of an hotter and more robuſt temperament, and who are apt to be heated by the waters, as well as by motion, are to chooſe the cooleſt air for drinking them, and by all means, keep themſelves temperately cool at and after drinking them. While thoſe, that have ſtrength, ſhould keep continually in ſuch gentle motion as may conſtantly keep them in a moderate temperature; taking conſtant care not to overheat themſelves, nor exhauſt their ſpirits.

§ 531. 2. The manner of drinking is next to be conſidered. None invalid ſhould take them without proper preparation. And different habits and diſtempers require different treatment. Thus, for the generality of fit objects, emptying the firſt paſſages onely, by a mild purge of the ſaline kind; ſuch as ſal polychreſt, ſoluble tartar, diuretic, Glauber's, Seignette's, Epſom, or Sadlitz ſalts; in the more tender conſtitutions, theſe may be ſtill moderated in their operation, by mixture with manna or extract of caſſia, or either of theſe taken alone in any agreeable vehicle. Some will require more than ſaline purges to cleanſe their foul bowels. Such may have any of theſe ſalts added to an infuſion of ſenna, with or without rubarb. If the bowels be very lax, warm bitters and aromatics may be added to the infuſion; and in ſome ſuch caſes, rubarb may be the onely proper purge. In theſe caſes alſo, vomits, as well to empty and cleanſe the ſtomach as to make ſome revulſion, may be neceſſary; eſpecially, where the reſtringent quality of the Ipecacuanha may be requiſite.

§ 532. Some groſs, corpulent perſons, that have fed fully and foully, uſed little or none exerciſe, and whoſe bowels are ſo furred, as to have loſſed their natural ſenſibility, and to have grown ſluggiſh in their functions, will require aloetics, Hiera picra wine, by itſelf, or added to the forementioned purgative, bitter infuſion; or the pills called Rufi's, or aloes with aromatics or fit ſalts, &c. reduced to this form. While ſome will require to be cleanſed and rouſed by the addition of ſome granes of emetic tartar to the bitter infuſion; which in ſome ſuch groſs and ſluggiſh habits, ſtuffed with the recrements of beef and pudding, or what is ſtill worſe, with incoherent French forced meats and Ragouts; cannot fail of finding great benefit from ſuch diſcharges, in every ſenſe.

§ 533. Thoſe of more delicate and irritable fibres, and more weak and tender frames, ſuch as are ſubject to hypochondraic or hyſteric affections, have their bowels beſt prepared by previous courſes of the fetid,

reſolvent gums, with ſope, with diuretic ſalt, ſalt of amber, or the like.

§ 534. And all, in caſe of coſtipation, during the courſe, muſt keep the body ſoluble, by taking, night or morning, ſome portion of their appropriate purge.

§ 535. In general, our waters are not fit for hot, ſanguine temperaments. Yet, it often happens, that ſome ſuch ſubjects require a courſe of theſe waters, and are not ſo effectually to be remedied by any other means. In theſe like habits, veneſection, with other evacuations, and low living, are always to be premiſed, and often interpoſed during the courſe; when a fulneſs of blood, pains in the head or bowels, or any inflammatory diſpoſition is ſeen to ariſe or threaten.

§ 536. But, the moſt material, the moſt effectual and univerſal preparation, for a courſe of theſe, or any other ſpirituous and ferrugineous waters, is warm bathing. The emptying and cleanſing the firſt paſſages are not ſufficient, if there be a rigidity of the fibres, an induration of the glands, a foulneſs, conſtriction or obſtruction of the pores of the ſkin. All ſhould be mollified and relaxed, every paſſage, as far opened, every tumor or obſtruction, as far ſoftened, and every pore as clean, open and free, as they may be rendered by the repeted application of a warm, univerſal bath, with friction, and ſome times, in ſome caſes, ſweating. And in a great variety of obſtructions, hepatic, ſplenetic, meſenteric and uterine, the ferrugineous waters are not onely greatly ſeconded and aſſiſted in their operation, by interpoſing warm bathing, during the courſe; but, in many caſes, where ferrugineous waters rather aggravate than aſſuage the ſymptoms; warm bathing will not onely render them tollerable, but more ſafe and effectual.

§ 537. Provident nature has moſt bounteouſly furniſhed the beſt general preparative for the uſe of Spa waters, within leſs than a day's eaſy ride of it; the little baths of Chaud-fontaine, on one ſide, and the great baths of Aken or Aix la Chapelle, on the other.

§ 538. But,

§ 538. But, the later are not onely a fit topical, but a moſt powerful internal preparative for the uſe of any ſpirituous chalybeate; as in treating of theſe baths will more fully appear. So that in moſt caſes, I find Spa waters beſt ſuccede after a courſe of the lixivial, deterſive and aperient waters of Aken.

§ 539. When the body is once properly prepared to receive theſe active waters, few or no ſhop medicines are neceſſary or fit to be taken. Yet here, as in moſt other water drinking places, the officious practicioners, to make themſelves appear of ſome conſequence, moſt impertinently interpoſe ſome incongruous compoſitions, that generally ſpoil the waters, of ſomething moſt valuable, if they do not actually deſtroy them or change their natures; ſuch as fixed or volatile alcalies, ſopes, mineral and vegetable acids, and the like. Yea, ſome there are, who pretend to improve upon the operations of nature, by inſinuating, that they can give the waters in epitome; even in the form of an extract. This is an arcanum, a boaſted ſecret, with ſome; which, upon examination, appears to be none other, than the Pouhon water evaporated to the conſiſtency of an extract; to which, ſome add an alcaline ſalt, and others with ſomewhat more deſign and reaſon, cream of tartar. The former of theſe is known by an acrid, lixivial taſte, cauſing an ebullition with all acids, and in not changing the color of an infuſion of galls. The other, ſuffers no change with diluted acids; has a ſweetiſh, ſtyptic, ferrugineous taſte, and does tinge an infuſion of galls purple. The former is foregne to the compoſition and intention of the water, and to be regarded onely as iron in a ſtate of precipitation; the latter, is impertinent, and foregne to the ſpiritual eſſence, the moſt active and powerful part of the water. They, that want artificial medicines, may take them at home. Such as come for the waters, ſhould take them in purity and perfection, which muſt be in ſimplicity.

§ 540. Moſt medicines may be looked upon as interruptions to the operation of the waters; and there-

fore none are to be taken without apparent neceſſity; as ſome mild aromatics, when they are found to lye cold on the ſtomach; ſome gently aperient medicine, when they are found to coſtipate; ſome nitre, or ſome mild acid, when they are found to heat, and the like. But theſe, as rarely as poſſible.

§ 541. For, all theſe and ſuch like inconveniences may, in mine opinion, for the moſt part, be obviated by a regular doſing and adminiſtring the water.

§ 542. It is impoſſible to aſcertain the doſe or quantity to be given at once, or the length of time, the uſe of theſe waters is to be continued: It is not to be imagined, a man can come to particulars in an eſſay, wherein, the practic part can onely be treated in the general manner.

§ 543. Patients of all conſtitutions and denominations are to drink theſe waters with due care and circumſpection. After journeying to the town, or rather to Aken firſt; for there, moſt ſhould begin; it is fit to repoſe ſome few days, and then take a ſlight ſhort courſe of theſe thermal waters, internal and external, in the manner layed down in it's place. Having, after this, arrived at Spa, or Malmendy, and there, reſted a day or two, the courſe of theſe waters, or whichſoever of them is found beſt appropriated to the caſe, is to be begun, the ſtomach and bowels empty, by drinking ſomewhat under half a pint, ſix, four or two ounces, according to the age, ſtrength and other circumſtances of the patient; at firſt, not much earlier, than the accuſtomed hour of riſing.

§ 544. If, in about half an hour after, no diſagreeable effects ariſe, ſuch as ſickneſs or uneaſineſs at ſtomach, unuſual heat, pain in the head, or the like; a ſecond glaſs of the ſame ſize with the former may be taken; moving gently about, if able, elſe, ſitting in a warm place, as is found moſt expedient. If it ſhould in the leſt diſagree, no more ſhould be taken that day.

§ 545. In about an hour after the laſt glaſs, or when the ſtomach is found eaſy and empty, a light breakfaſt of tea, coffee, chocolate, gruel, light broth, or milk,

milk, where the patient is hot and thin, with bread or biſcuit, may be taken.

§ 546. About half an hour, or an hour after breakfaſt, it will be proper to take the air, on horſeback, in a carriage, or on foot; as the ſeaſon and circumſtances will admit; avoiding all extremes of cold, heat, and fatigue.

§ 547. About two, is found the lateſt hour, at which the water drinkers can properly dine: Dinner ſhould be chiefly animal food, freſh fleſh or fiſh, planely dreſſed, either roaſt or boiled, light ſoups and broths, with celeri, &c. All mealy roots, acid or aſceſſent herbage or fruit are to be avoided. The drink ſhould be any generous fermented liquor, mixed with water, at meals, and ſome few glaſſes plane after, to ſuch as are accuſtomed to uſe it.

§ 548. After dinner, more gentle exerciſe is to be taken, as much as may be in the open air. Taking care to avoid the evening dews, by returning home timely, and ſpending the evening in ſome agreeable recreation, in cheerful, agreeable company. Always taking care to keep the mind in as perfect a ſtate of diſſipation, as free from all ſorts of care, and as little agitated or acted upon by paſſions of any kind, as poſſible. I dare not well recommend gaming, where ſuch numbers make it the ſhameful occupation of their lives; taking trading voyages or journies to places of this kind, to get a ſcandalous livelihood, and ſometimes, to amaſs fortunes at the expence of ſuch dupes, as run into their meaſures; and make what was onely intended as an innocent amuſement, a deep deſigning, as well as a ſordid, infamous, crafty buſineſs and ſtudy.

§ 549. The regular patient, retiring early from his amuſements, with a tranquile mind, may take a very light ſupper, or none at all, if he has not ſome uneaſineſs without it. A bit of bread, and a glaſs or two of any light generous wine, can hardly prove injurious, and may be proper. Or, for thoſe, who are of a thin, dry habit, a little, light ſimple broth, or gruel, a

thin

thin cuſtard, or a little milk with bread, may not onely be allowable, but neceſſary.

§ 550. The ſecond day, all things having gone on well the firſt, the patient may riſe a little earlier than the preceding, and ſo on, day by day, till he gradually brings himſelf to the earlieſt hour, at which it is proper or neceſſary to drink the water. Let the ſecond, and ſome five or ſix following days paſs, without increaſing the quantity of water, beyond two glaſſes; though it proves ever ſo agreeable. If it ſhould diſagree, let a day, two or more be intermitted; and, if neceſſary, proper medicines interpoſed to correct the malady.

§ 351. After the fiveth or ſixeth day, the doſe of the water being found not onely tollerable, but grateful to the ſtomach and general oeconomy; let each doſe be increaſed by an ounce or two, till half a pint be conveniently borne; but, ſmall, weak ſtomachs are not to be diſtended beyond their natural bounds and ſtrength by any means. Let the doſe, not the number of glaſſes, be thus gradually increaſed, for a few days; with ſtrict caution not to overburden or offend the oeconomy, in any inſtance.

§ 552. When a moderate draught is found to ſit light and eaſy on the ſtomach, and a repetition of it, at about half an hour's diſtance, gives none offence, for ſome days ſucceſſively; a third glaſs may be taken, after the like interval, as interpoſed between the firſt and ſecond.

§ 553. When this quantity is found to agree, and the natural diſcharges, by urine and ſtool, are regularly carried on, for two or three days; the number of glaſſes may ſtill be increaſed, by one in a day for two or three days; and ſo on gradually, till it be found to paſs off freely, and not to oppreſs the ſtomach, taken at ſhorter intervals, ſuch as twenty or fiveteen minutes, to ſix or eight glaſſes, before breakfaſt.

§ 554. Or, if there ſhould not be time or room for ſo much, before breakfaſt, or that it ſhould happen to purge or paſs off too ſuddenly by urine; in ſuch caſe,

caſe, a glaſs or two may be taken an hour, or half an hour before dinner, and as much, four or five hours after dinner, or an hour, or half an hour before ſupper; yea, going into bed, after a light, agreeable ſupper.

§ 555. When the oeconomy becomes thus well accuſtomed to the water, it may properly be drank at meals, plane or with wine. And provided the food be not unfit for the general courſe, it can not diſagree with the water; for, all thoſe of this part of Germany ſerve well to boil fiſh, fleſh and vegetables, without changing either their taſte, color, or qualities; for, they become ſoft, and in ſome meaſure lixivial and fit for theſe purpoſes, as ſoon as the volatile ſpirit has eſcaped, and the iron has precipitated, as both do in the firſt boiling heat. Let no body be ſurpriſed at the waters' changing the color of the wines: For, they deepen the purple of the red, give the white wines, and even brandy or rum, a purple hue. In the wines, this may be owing to a double cauſe; the reſtringent part of the ſkin of the grape, and the aſtringent part of the caſk, which is generally oak. In the ſpirits, it is owing to the wood alone: For, ſpirits, that have not touched vegetable bodies will produce no ſuch, nor any change of color.

§ 556. The time neceſſary to continue a courſe of theſe waters is not more eaſily determined, than their doſes. Some find immediate effects from them; ſome feel none, for ſome time after the courſe. None can expect permanent effects from leſs than three weeks or a month's regular drinking. And moſt require ſix weeks, ſome twelve. I have known ſome obſtinate caſes, in which, the patients remaned at Spa, and continued drinking the waters, more or leſs, for above a year. Moſt may, by this means, render theſe waters, or any medicine, ſo familiar to the oeconomy, as to find but little benefit from them, in the way of a remedy. Therefore, when a longer courſe than a month or ſix or eight weeks is found neceſſary; it will be beſt to intermit ſome time to wait their effects, and return to them again, upon occaſion.

§ 557. But,

§ 557. But, that nature may ſuffer no ſudden ſhocks, by the taking, or leaving off, ſo powerful, ſo active a medicine as theſe ſpirituous, ferrugineous waters are found; I think it adviſeable to inculcate, more ſtrongly than ordinary, a caution, which I have already ſhewn to be juſt and neceſſary, in a courſe of the ſimpleſt waters: I mean that of beginning with a very ſmall quantity, increaſing it, by ſlow and almoſt imperceptible degrees, to the pitch, that is judged expedient and neceſſary; then, after continuing that quantity, for the ſpace of time, found proper; to decreaſe them, by the ſame ſlow degrees, by which their doſe was augmented.

§ 558. When it may not be convenient to ſtay at the wells, the length of time neceſſary for this courſe; the patients may load their carriages with proviſion of the water, and take it upon their journey, and ſome time after their return. And this, I have found, ſo much better, than dropping the uſe of the waters ſuddenly, that I have conſtantly preſcribed it to my patients, with deſireable ſucceſs.

§ 559. The pure natural air, and the ſimple manner of life, the regular hours and pleaſing courſe of amuſements there, contribute not a little to the reeſtabliſhment of health at thoſe ſalutiferous ſprings. The ſame arguments hold againſt relaxing this courſe, as againſt quitting that of the waters, ſuddenly. To enforce theſe, reaſon and moraſity, with all the rules of phyſic, concur. But, as we ſhall have occaſion to ſpeak to this point more at large, in ſpeaking of the internal uſe of Aken water; I muſt, to avoid repetitions, which is not eaſy, in a work of this kind, refer the reader to that tract.

The End of the Essay on Subacid, Chalybeate Waters.

AN

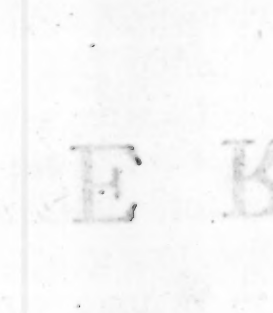
ESSAY

ON

WATERS.

PART III.

Of NATURAL BATHS.



THE CONTENTS.

PART III.

SECTION III.

The

Aken

Of NATURAL BATHS.

SECTION V. By miſtake, marked VI.

Of the CITY *and* WATERS *of* BATH.

The END.

The End.

ERRORS to be corrected in the reading.

PART III.

BATHS *of* AKEN.

§ 3. l. 7. for use, r. it.
8. for them, r. it.
§ 7. l. 9. and elsewhere, for fountains, r. fountanes.
Page 14. l. 25. for the, r. this.
§ 12. l. 5. after of, d. a.
§ 15. l. 8. for PLETTENBERG, r. PLETTENBERG.
l. 9. for VITTIM, r. WITTIM.
§ 17. l. 17. for LESOINE, r. LE SOINNE.
§ 53. l. 2. for ash color, r. ash colored.
§ 72. l. 6. for furni shseveral, r. furnish several.
§ 85. l. 3. for red, r. yellow.
§ 121. l. 2. for course, r. coarse.
§ 123. l. 2. for Lilly, r. Lily.
§ 130. l. 3. for copice, r. coppice.
§ 143. l. 30. for Sovereigne, r. Sovereign.
§ 161. l. 21. for vapor, r. vapote.
§ 165. l. 2. for pelucid, r. pellucid.
l. 27. for pelucidity, r. pellucidity.
§ 166. l. 30. for Aethiop's, r. Aethiops.
§ 185. l. 7. after yield, add, a neuter salt, consisting of.
§ 186. l. 5. for volatised, r. volatilised.
§ 192. l. 2. for mineral, r. vitriolic.
§ 205. l. 28. after remane, add, unless in some bituminous or oily matter.
§ 208. l. 5. for died, r. dyed.
§ 209. l. 30. after resembled, add destilled.
§ 217. l. 4. for milkey, r. milky.
§ 225. from this to the end, the number of each to be increased by ten; as for § 216, r. § 226, &c.
§ 260. l. 2. for parts, r. fourths.
§ 269. l. 27. 28. instead of, because these, like the fixed stall, particularly the later, r. because these, particularly the later, like the fixed stall.
§ 274. l. 6. for these, r. those, after of, add, the.
§ 287. l. 4. for appeared, r. appear.
§ 302. l. 5. for subsided, r. subsides.
§ 314. l. 16. after earth, add, chiefly.
§ 335. l. 5. for encrusts, r. incrusts.
§ 338. l. 10. and elsewhere, for scruples, r. scrupules.
Page 110. l. 23. for X. r. XII.
§ 349. l. 15. for fallen, r. dropped.
l. 16. after this, add, imaginary.
§ 380. l. 28. for alcailne, r. alcaline.
§ 382. l. 10. § 390. l. 5. and else where, for peter, r. petre.
§ 403. l. 26. for tute, r. tuto.
§ 411. l. 12. for aparel, r. apparel.
§ 421. l. 8. after and, add, the.
§ 423. l. 12. for arrid, r. arid.
§ 429. l. 4. after inactive, add, lives.
§ 438. l. 5. for luxrious, r. luxurious.
note b; for sympofac, r. sympofiac.
§ 446. l. 9. for an acid, r. a grosser acid.
§ 448. note a; for BAUCIS, r. BACCIUS.
§ 453. l. 39. after seasons, add, later, together with.
§ 459. l. 7. after fluid, add, as this.
§ 466. l. 4. 6. for it is, r. is it.
§ 482. l. 7. for STATTIUS, r. STATIUS.
§ 496. l. 16. after mine, add, actual.
§ 504. l. 7. for acrue, r. accrue.
§ 509. l. 9. after weak, add inattentive.

BORSET BATHS.

§ 56. l. 29. for linnen, r. linen.
§ 61. l. 2. for sensibls, r. sensible.
§ 89. l. 3. after which, add, I.
§ 98. l. 6. for mutiplly, r. multiply.

BATH WATERS.

Page ccxv. for ripriſals, r. repriſals.
§ 1. l. 24. after who, add, unfortunately.
§ 2. l. 3. for Bladdule, r. Bladud.
§ 3. l. 12. for calicli, r. calidi.
§ 5. l. 12. for Bathenceſter, r. Bathanceſter.
§ 7. l. 22. 23. 24. instead of, Antique as the curious may expect it, I ſhall give ſome account of theſe ruins; r. A

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r. As the curious may expect it, I shall give some account of these antique ruins.
§ 9. l. 5. 6. for II Plates, r. Plate II. Fig. 1.
§ 12. l. 7. for plebeans, r. plebean.
14. l. 13. after of, add, stone.
23. l. 13. for p bbles, r. pebbles.
24. l. 3. for Whe her, r. Whether.
26. l. 2. for genius, r. geniuses.
41. l. 8. for lies, r. lyes.
50. l. 3. for lead-ore, r. lead ore.
55. l. 12. for do, r. does.
58. l. 13. § 59. l. 7, 10. and universally, for empyricism, r. empiricism.
§ 61. l. 5. for it, r. the city.
l. 38. after but, add, that of commonage, and.
§ 76. l. 19. for acuracy, r. accuracy.
§ 86. l. 23. for waste and waste coats, r. waist and waist coats.
§ 104. for 16. r. 13 grains.
§ 128. l. 5. for martial r. material.
142. note a, add, §.
§ 146. l. 70. for could r. should.
§ 148. l. 6. for production, r. substance.
§ 159. l. 2. for give, r. gives.
§ 171. l. 21. for contain, r. contains.
§ 176. l. 20. for absorbent, r. absorbents.
§ 177. l. 3. for experiment, r. experiments.
§ 193. l. 5. for slides off, r. sides of.
§ 237. l. 21. for no less, r. not much less.
§ 242. l. 6. after together, add, striking.
§ 270. l. 3. for forregner, r. foregner.
§ 292. l. 10. for to it, r. it to.
§ 293. l. 26. for their, r. the.
§ 304. l. 3. for that, r. those.

BRISTOL WATERS.

§ 12. l. 4. for a, r. an.
22. l. 11. for is, r. was.
§ 32. 3. for apppearances, r. appearances.
§ 40. 5. l. 2. for the left, r. the smallest.
§ 62. l. 4. after as, r. in.

ERRORS to be corrected in the reading.

PART II.

INTRODUCTION.

§ 14. l. 11, 12. for Chymiſt and Chymiſtry, r. Chemiſt and Chemiſtry.
§ 16. l. 10. for chymical, r. chemical.
l. laſt for ſucceeding, r. ſucceding.
§ 18. l. 8. for ſyrup, r. ſirup.
l. 11. for acuracy, r. accuracy.
§ 23. l. 9. for combinations, r. combinations.
§ 35. l. 13. before vitriol, add, with.
§ 49. l. 27. 28. for precipitated, r. precipitating.

Of SALT WATERS *in general.*

§ 6. l. 3. for ARISTOTLE, r. ARISTOTEL.
in note b, for Remetallica, r. Re Metallica.
§ 14. l. 4. for METHIOLUS, r. MATHIOLUS.
l. 7. 8. } and elſewhere, for moun-
§ 15. l. 6. } tain, r. mountane.
§ 27. note a; for Stefford, r. Stafford.
§ 40. l. 8. for ſubline, r. ſublime.
l. 14. after the, add, ſpecific.
§ 48. l. 13. after it, add, rapidly.
§ 50. l. 17. for practicioners, r. practicioner.
§ 61. for oz. r. ounces.
§ 75. l. 5. for ſuffers, r. ſuffer.
l. 7. for ſuffer, r. ſuffers.
§ 91. l. 17. after or, add, in which it.
l. 18. after part, add a, and d. in.
§ 95. l. 13. after all, add, of.
§ 104. l. 12. for vellicaion, r. vellication.
§ 106. l. 6. for picle, r. pickle.
§ 108. l. 8. and elſe where, for empyrical, r. empirical.
§ 133. l. 9. after this, d. among.
§ 163. l. 3. for heard, r. heared.
§ 177. l. 11. for erecting, r. erecting.
Page 94. for SECTION III. r. IV.
96. to page 103. l. 1. for WATER, r. WATERS.

EPSOM WATER.

§ 9. l. 4. for coaleſced, r. coaleſces.
l. 4. for precipitated, r. precipitates.
§ 10. l. 3. for coagulated, r. coagulates.
l. 4. for precipitated, r. precipitates.
§ 24. note a; for § 9. r. § 10.
note b; for § 20. r. § 21.
§ 37. l. 5. for falſly, r. falſely.

CHELTENHAM WATER.

§ 4. l. 18. for tarter, r. tartar.
Page, 112, l. 1. for SECTION IV. r. V.

SUBACID, CHALYBEATE WATERS.

§ 15. l. 23. after water, add, and.
§ 36. l. 5. after that, add, are.
§ 37. l. 2, for ſourſe, r. ſource.
l. 9. for foſſil, r. fiſſil.
§ 43. l. 4. after ſpring, r. ſayed to be.
§ 45. l. 11. for lyes, r. lye.
§ 49. l. 33. for leaves, r. leave.
l. 34. for diffuſes, r. diffuſe.
§ 50. l. 51. after and, add, was.
l. 63. for demonſtrat d, r. demonſtrated.
§ 51. l. 5. for Sar, r. Sart.
§ 52. l. 14. after the, add, river.
§ 53. l. 8. for ſende, r. fends.
§ 65. l. 4. after itſelf, add, in ſome places,
l. 5, after water, add, in others.
§ 86. l. 15. after iron, add, diſſolved in water.
l. 21. after proper, add, in ſuch caſes.
§ 91. l. 12. for a, r. oppoſite for direction, r. directions.
§ 103. l. 21. after or, r. alternate.
No. 4 l 1. after of, add, the.
§ 162. l. 9. for remander, r. remaneder.
§ 179. l. 6. for n ne, r. nine.
§ 243. l. 3. for § 148 r. 148.

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§ 252. l. 2. for of, r. at.
§ 264. l. 17. for think, r. thinking.
§ 268. l. 23. for Paracelsus, r. Paracelsus.
§ 272. l. 21. for subtil, r. subtil.
§ 273. l. 41. for ciment, r. cement.
§ 307. l. 3. after 271, add, is.
§ 308. l. 2. for ballance, r. balance.
§ 336. l. 7. r. such hold.
l. 8. after it, add, such hold.
l. 13. for and, r. or.
§ 344. l. 5. for is, r. it.
§ 393. l. 3. for cansed, r. cause.
§ 396. l. 4. for is, r. are.
l. 6. after color, add, as well as;
§ 398. l. 1. before The, add, I.
§ 405. l. 3. after preceding; add, but,
§ 436. l. 2. after each; r. other.
§ 446. l. 3. for admirable, r. a subtil.
§ 508. l. 19. before English, r. some.
§ 529. l. 10. for the by, r. the bye
§ 537. l. 9. for these, r. those.
§ 533. l. 3. for hypochondraic, r. hypothondriac.

SECTION I.

Of the CITY *and* THERMAL WATERS *of* AKEN.

Addreſſed

To the RIGHT HONOURABLE

The EARL of SHELBURNE.

My LORD,

THE long-practiſed abuſe of Dedications has made the very name of addreſſes of this kind, as ungrateful to the ear of the truly noble Patron, as offenſive to that of a modeſt Client. And, when Your Lordſhip forbids even private acknowledgements of the greateſt obligations; there is much room to fear, mine humble offering, in this way, can hardly be acceptable.

Yet, MY LORD, when You conſider, that a generous mind muſt be as ſollicitous to return or aknowledge, as You are to confer obligations; when you reflect, that the higheſt obligations could never procure any ſhare of my friendſhip, poor as it may be, to the unworthy, in the higheſt ſtation; and that no degree of awe, nor the utmoſt favor was ever able to extort from me the ſlighteſt expreſſion

of ſervility or adulation to any; You will, of your abundant humanity, permit me at once to indulge my pride and gratitude, in thus preſenting your Lordſhip with one of the firſt fruits of my phyſical labors, which have been ſo generouſly encouraged, ſo kindly cheriſhed by the genial warmth of your friendſhip and bounty.

I ſhall not ſhock your Lordſhip's modeſty with vanely attempting, within the narrow compaſs of this addreſs, to blazon out the Atchievements or Pedigree of thoſe illuſtrious families, whoſe titules of honor, as well as fortunes, center in Your Lordſhip.

However piouſly you pay juſt reſpect to the dead; You greatly diſdain to rely on honors titularly tranſmitted through a long line of noble anceſtry. You wiſely judge, that whoever of theſe was moſt richly freighted with that moſt rare and pretious commodity, Virtue; had little enough for himſelf. You think it a kind of ſacrilege to rob the dead. And therefore, not contented with the ordinary hereditary clame to a large patrimonial ſtock; You, as it were rejecting all outwardly reflected forms of honor, have bravely reſted upon your own innate fund.

Theſe, My Lord, muſt ever ſecure You the juſt eſteem of the wiſe and good. The World and You will pardon mine ambition in approaching this venerable claſs. I ſhall alſo

hope

hope to be indulged, if I publiſh the pride, I take in that ſhare of friendſhip, with which You have honored me.

As Your Lordſhip's propenſity to acts of humanity and benevolence, as well public as private, is equalled by nothing, but your generous ſollicitude to concele them; I muſt in common juſtice, in this inſtance at leſt, violate your commands, and tell the world the motive of this public addreſs.

I ſhall, for the preſent, overlook Your noble encouragements of induſtry and arts in general, and your particular munificence to the univerſity of Dublin; They ſpeak for themſelves. I mean onely to eaſe mine own mind, by giving a public teſtimony of that gratitude, which pure modeſty and nice generoſity would not permit Your Lordſhip to accept in private.

In my proſperity, I was honored with your countenance in Ireland. In that, notwithſtanding mine inferior rank, there was nothing uncommon; the proſperous never want worldly friends. But, My Lord, Your regard, with an exulting heart I tell it! was of a more pure and exalted nature. Of this, Adverſity gave the never-failing teſt: For, when the oppreſſive paws of lawleſs rulers ſtripped me of all the rights and privileges of a free-born ſubject, in mine own country; reduced me to the loweſt ebb of fortune, and to exile; my diſtreſſes were greatly mitigated, my loſſes rendered tol-

 lerable,

lerable, if not inconſiderable, when I found they enhanſed and ſecured me the invaluabe regards of men like You. Theſe ſupported my drooping ſpirits in exile, and taught me to ſmile amidſt adverſity.

Muſt I not remember, muſt I not acknowledge theſe great inſtances of human excellency?—Rather than be unmindful of them, let my right hand forget it's cunning!—Nor can I in ſilence paſs over Your Lordſhip's extreme liberality in patroniſing my courſe of chemiſtry. If this has been of any uſe to the public or has given ſatisfaction to a few individuals; they are indebted for it to the extraordinary munificence of LORD SHELBURNE; without which, there had been none encouragement here for ſuch an undertaking.

Thus, My Lord, have I once more relieved myſelf at your expence. See my ſelfiſh diſpoſition! My boſom was oppreſſed with a deep ſenſe of your benefits. And I knew no way of lightening the burden, without breaking through the vele, which you ſo aſſiduouſly throw over the nobleſt actions, that the left hand hardly knows what the right effects.

You will forgive me then, My good Lord, if, in one inſtance, I have been thus forced to revele theſe ſecrets, with which you intruſted me; when You conſider the power of the temptation, that aſſailed me: I muſt ever be anxious to get out of debt. This alas! I have no means to effect. But, thanks to our poet!

I have one way of obtaining comfort, though not a full discharge: I cannot be ungrateful; nor bear the shadow of the imputation. If then, the grateful mind by owing owes not; but, by gratitude alone, still pays, and stands at once indebted and discharged; for this public, I hope my sole, transgression, the World and You will pardon,

My LORD,

Your LORDSHIP's

Most obliged,

Most faithful,

And

Most obedient servant,

C. LUCAS.

Of the BATHS *of* AKEN *in general.*

§ 1. THE hiſtory of theſe moſt famous waters, as well as the etymology of the different names, by which they are known, in various languages; are too far involved in the obſcurity of antiquity, fable and ſuperſtition, for a mere enquirer into matters purely phyſical, to ſpend time in the inveſtigation of either.

§ 2. The waters of Aken have probably been known and in repute, as early as we have any authentic account of the peopling that part of Germany, formerly Tranſalpine Gaul, in which they ſprung. And theſe waters, no doubt, gave riſe to the building of baths about them firſt, and afterwards, to the founding that conſiderable city, which takes its name from its waters or baths, and which has increaſed in riches and grandeur, in proportion, as its baths have been frequented by ſtrangers of diſtinction.

§ 3. Theſe waters were antiently known by the ſimple apellation of Aquae, by way of preeminence, The Waters. Afterwards, they were diſtinguiſhed by a ſurname of as uncertain etymology, as ſignification; as Aquae Grani, Aquae Graniae, Graniaquae, Aquae Graneae, and by ſome, Aquae Gratiani; the origine of which are ſo ill founded and fabulous, that a ſerious writer muſt bluſh at reciting them.

§ 4. The firſt diſcovery of theſe waters is attributed to one Granus, ſayed to be a Roman ſenator; by ſome ſuppoſed to be a brother of Nero, by others, of Agrippa; who, being proſcribed, fled into this part of Gaule; whileſt others give it to one M. Serenus Granus, ſayed to have been ſent proconſul into this province, by the emperor Adrian. Of theſe numberleſs, ſenſeleſs romances are handed about the town, by the vanity of the inhabitants; who pride in its pretended Ro-

Roman foundation and antiquity; and these are chronicled by credulous civil historians, and published by numbers of as weak natural historians, in idle treatises on the waters; with which all water-drinking places and baths abound, as modern news papers with quack-bills of an other cast.

§ 5. From these, the city was called, at first Aquae, afterwards, Urbs or Civitas aquensis, the people, Aquenses, as the baths were called, Thermae aquenses; afterwards, the name of Aquisgranum and Aquisgranensis prevaled and obtained universally. The most probable account of which, is best collected from certain antient monumental inscriptions, to Apollo of Grannus, or the Grannian Apollo; of which mention is made by several respectable German historians[a], of which, the first author tells us of three; two in different parts of Germany, which he names, and one at Rome. There was likewise one found at Colmar in Alsace, in the year 1726; in these words.

APOLINI GRAN
NO MOGOUNO
Q. LICINIUS TRIO.
D. S. D.

This is construed by several curious antiquarians, German and French, as something analogous to what was formerly recorded in the temples of the Gods supposed to preside over health; or to what, of later date, we have seen set up in churches and at baths and wells, as the vows of votaries, who received particular benefit from the god, saint or other divinity, to which it is dedicated or addressed. The worship of Apollo was once very universal; but in no place more general, than in Germany, as appears by the multitude of these like inscriptions found there. No-

[a] VELSERUS. Rerum Vidnolic. August. Comment 1594. Act. erudit. LEIPS. T. ix. in supplem.

thing

thing was more common, among the antient Romans, than to conſecrate medicinal ſprings and baths to Apollo, the god of health, or the ſun; from whom all things, according to their philoſophy, derived their origine and virtues. And that god was given an epithet or ſurname from the place, where his temple ſtood, or his oracles were delivered. Thus, he was in one place, the Delphian, in an other the Grynaean Apollo, and in Germany, the Grannean, perhaps by corruption from the Grynaean grove. Thus, the modern Romaniſts, who keep up to the primitive ſuperſtition and ſometimes inlarge it, give their deities different denominations, from the places, where they judge them moſt propitious, or where the richeſt ſhrines and altars are erected to them. But, whether the pagan divinity gave name to theſe baths or this city, or they to him, is fortunately not very material; ſince, the queſtion is not eaſily decided. There remanes in the town a very antient tower, which makes a part of the town houſe, and which is to this day called, the tower of Granus; but whether it was a civil or religious building is not eaſily determined; as it has ſuffered by the viciſſitudes of time, the different conflagrations, which the city has ſuffered, and the addition of new buildings to it. This incertainty is no bad plea for its antiquity.

§ 6. This place is called, by the Germans, Aach or Aachen; as is ſuppoſed, from Ach, an interjection of ſurpriſe; as if one ſhould ſay, Hah! or hah! hah! being ſurpriſed with the unexpected heat or cold of any thing; the word, imagined to have been uſed, by whomſoever firſt accidentally diſcovered theſe waters. By the Low Dutch and Flemings, it is called, Aken. By one of which appellations, as nearer the idiom of our language, this place ſhould have been known to us; had not a ſhameful ſervility to French modes made us embrace the modern name of Aix, which is probably a corruption of Aquis; an appellation, which they give to the principal natural

tural baths, where their language prevales, distinguishing them, the one from the other, by some epithet; thus, the town in France, called from its waters, Aquae Sextiae, is called, Aix en Provence, by the French; as that, from the like cause, known to the Romans by the name of Aquae Allobrogum, which is the Aquae Gratianae, not those of Aken, as some [a] will have it; is now called, Aix en Savoye; and Aachen, Aix la Chapelle; as if one should say, Aquae, or the baths, distinguished by the famous chapel of the emperor, Charles the Great.

§ 7. We do not find any thing remarkable of the city of Aken, before the time of this great monarch. Who may be therefore looked upon as the founder of the city, and the restorer, not the discoverer of the baths; as he is reported to have been, through a kind of fabulous superstition, and a desire to have their founder, and now their tutelar saint, the discoverer of these famed fountains of health.

§ 8. I do not mean to say, that Charles the Great was the original founder of the city of Aquae or Aachen; for, that there was a royal palace and magnificent baths, for the time, and a city there, before his birth, is most certain: Because we find, in the French king's collection, a golden medal, struck at Aquae, for Pepin the short, king of France, and father to this emperor. It is moreover recorded of this king, that he, attended with his whole court, celebrated the feast of Easter, more than once, and at another time, bathed, and passed the whole winter, here. So that there must have been baths and a city, called from them, Aquae, in his time. But, no doubt, his son and successor, Charles, rebuilt the baths and palace, in the manner he left them, and the city, in the form in which we see it at this day; and gave the superb titules, it bears and the extraordinary privileges, which the citizens have since him enjoyed. And, after having completed the public buildings, he here founded the seat of the western empire; as appears by his charter granted

to

[a] Sylburg.

the city, as well as by an inſcription, ſet up over one of the principal gates of his palace, in theſe words;

HIC REGNI SEDES TRANS ALPES HABEATUR CAPUT OMNIUM CIVITATUM ET PROVINCIARUM GALLIÆ;

That is; Be this the ſeat of empire beyond the Alpes, the capital of all the cities and provinces of Gaul.

§ 9. It was then allowed to hold the ſecond rank among the cities of Europe, giving precedence onely to Rome. But even this was not conceded long; For, OTTO I. in his charter, gives Aquiſgranum or Aachen the pompous titule of CAPUT ORBIS; the metropolis of the world.

§ 10. Of a piece with this, is a part of a ſolemn hymn, in monkiſh rhyme, ſacred to the memory of Charles the great, and ſtill ſung in the church, by him founded at Aken, on certain feſtivals;

URBS AQUENSIS, URBS REGALIS,
REGNI SEDES PRINCIPALIS,
PRIMA REGUM CURIA.

That is, AKEN is a Royal City; the ſeat of Empire; the Chief Court of Kings. This is the inſcription on the coin of this famous city, round its arms, which are thoſe of the empire of Germany; an eagle with one head diſplayed, ſable, on a ſhield argent; ſupported by a naked man, with his head in a royal helmet, and crowned with an imperial diadem; holding in each hand a banner, with the ſame enſigns armorial on each; the creſt an eagle crowned.

§ 11. This city is famed, among the ſuperſtitious, for many extraordinary reliques of ſaints, and ſuch like holy trumpery, and among hiſtorians, for having long been the ſeat of the weſtern empire; for having ſtill ſome of the regalia neceſſary to the coronation of the emperors of Germany; for having ſeveral great coun-

councils and congreſſes, civil and religious, antient and modern, held in it; of which, the curious in theſe matters may be further ſatisfied by reading NOPII Chronicon Aquiſgranenſe; PETRI a BEECK Aquiſgranum, ſive Hiſtorica Narratio de Regia c. R. I. et Coronationis Regum Romanorum ſedis, Aquenſis civitatis, origine ac progreſſu, &c. Jo. GEORGII Van ECKARD, Diſſertatio de Apolline Granno, &c. Franc. BLONDEL, Thermarum Aquiſgranenſium et Porcetanarum Elucidatio et Thaumaturgia. From whence, all we have on this ſubject in the later writers, are tranſcribed. And now, procede we to matters of greater moment to the phyſical enquirer.

Of

Of the ſize, ſituation and civil oeconomy of the city of AKEN; *of the air, climate, ſoil and ſimple waters of the city, its territories and vicinage; and then, of its medicated waters, or baths.*

In pure Reſpect
To the general good Senſe, Integrity and
Public Spirit,
Of
The SENATE and CITIZENS of AKEN,
As a grateful Acknowledegment
Of
Their particular Regard
To
The BRITISH NATION,
And
To commemorate
The extreme Politeneſs
Of the MAGISTRATES,
In attending and laying open
The GREAT and other SOURCES
Of their moſt curious BATHS
To the Inſpection of the AUTHOR;
The Diſquiſition on the Subject
Is preſented,
With all due Eſteem and Humility,

To

To the moſt Eminent and Worſhipful
The BURGOMASTERS-REGENT,
FRANCIS DE FURTH, Scapin,
MARTIN LAMBER DE LONEUX, Mayor
of Bordſcheit;
The BURGOMASTERS,
ALEXANDER THEODORE D'OLIVA, Scapin,
JAMES NICLAS,
And the reſt of the Scapins, Officers and
Citizens of that renowned CITY and
REPUBLIC.

§ 12. AKEN, or Aix la Chapelle, is a free and independent city, called an hans or imperial town, under the protection of the emperor of Germany, not in ſubjection to him. It is a kind of a republic; being governed by four burgomaſters, two of whom, alternate years preſide; with ſcapins, in the nature of our aldermen, and a kind of ſenate or common council; all appointed by a popular election. Conſequently, their government is free and popular.

§ 13. The utmoſt extent of their territories is about three Engliſh miles from the town; in many places, it is not near ſo extenſive; particularly, to the ſouthward; where the ſeigneury of the abbey and village of Bordcheit, or Borſet, veſted in the abbeſs, comes within half a quarter of a mile of one of the ſouth gates of the city.

§ 14. The town conſiſts of two parts; the old town and the new, or the city and ſuburbs. The old is of a round or kind of oval figure; like moſt old towns, irregularly layed out; but, with wide, open ſtreets, with good, regular, well built brick or ſtone houſes,

houſes, ſince the laſt conflagration; of which there have been ſeveral, not leſs than five or ſix, while their buildings were chiefly wood. In one of theſe burnings, which happened in the year 1656, twenty churches and upwards of five thouſand houſes were conſumed; by which an idea of the ſize of the town, in thoſe days, may be conceived. This was called, Urbs Carolina, from its founder or reſtorer, Charles the great. It was then, invironed by a ſtrong fortification, in the old Roman manner; conſiſting of a very ſtrong wall, with a deep, broad ditch, filled on moſt ſides with water, in thoſe days; but ſince, filled up in ſome places and dried in others, and would have been by now totally freed from water, did not a dread of fire ſo ſtrongly engage the breaſts of the governors, as well as governed in general, that they take care, there ſhall not be a ſcarcity of water upon any future emergency, that may ariſe.

§ 15. This wall was ſtrengthened with towers and gates in the antient method of fortification. But, as the fame of this city and its unparalleled waters extended, the antient boundaries of the Caroline city proved too confined; wherefore, another circular wall of better workmanſhip, and greater highth and ſtrength, than the firſt, and furniſhed with ſtronger and loftier gates, watch-houſes and towers, and a deeper and more inacceſſible ditch, was built at about a quarter of a mile circuit of the other. This incloſure, by ſome writers, is called, Pomoeria, but improperly: For, a great part of this ground, eſpecially adjoining the old avenues to the Caroline city, is as well or better built, than the inward city; whileſt a conſiderable part of the more remote is converted into gardens and meadows. Hence, there is no part of either town ſo crowded with buildings, as to ſpoil the air. Almoſt every houſe has a garden; and ſome of thoſe in the outward town have conſiderable gardens, with ſo much of the conveniencies of the country, though in-

incloſed within the walls of a city, that they may well be looked upon to enjoy Rus in Urbe.

§ 15. This town ſtands in north latitude 50 degrees, 48 min. longitude 25. 36. in that part of the German empire, which is called, the circle of Weſtphalia, between theſe two famous rivers, the Meuſe or Maes and the Rhine. Its territory is environed by the dutchy of Juliers, to the north and north eaſt; by that of Limborg, to the ſouth and ſouth weſt, and by ſome part of the eſtate of the Count of PLETTENBERG VITTIM, and part of the territories of the united provinces of Holland, to the weſtward. It is diſtant, about twenty miles to the eaſt, from Leige; ſixteen ſouth eaſt, from Maſtrecht; from Juliers, about fiveteen miles, to the ſouth weſt; and about thirty ſix weſtward of Cologn; and about twenty four north eaſt of Spa.

§ 16. This happy ſituation furniſhes this city with all neceſſaries of life, and even of luxury, in great plenty and perfection. And there is no city, on the continent, where ſtrangers may live more at their eaſe, in greater freedom, or better ſupplied for dreſs, carriage, bed and board, than Aken.

§ 17. Its inhabitants are induſtrious, moſtly merchants and artiſans. Their chief commerce conſiſts of their own manufactures, which are chiefly needles, which they make in great quantity and of excellent quality; and woollen cloaths, wrought chiefly of Spaniſh wool. Theſe, they make light and neat, and dye exceding well, of any one, but no mixed, color; and ſend them by land carriage all over the continent, even to Naples; bringing in return ſuch commodities as they want. The people are plane and honeſt in their dealings, and poſſeſs much of the old Engliſh temper and ſimplicity of manners; though they be mixed with Walloons, and ſome of them ſpeak French. And if I may judge of the natives in general, by thoſe with whom I became acquainted, Mr. HENRY SCHMITZ, merchant and banker, the phyſicians GATZWEILLER,

LESOINE, HEUSCH, father and ſon, GILLEAUMES, Mr. COBERG the apothecary, and many other eminent citizens, I may ſafely pronounce, there is not an honeſter, more obliging, or more ſociable and hoſpitable people, than thoſe of Aken; and ſtrangers in general might find them excel in the later inſtances particularly, had not the beggarly pride of a deſpicable nobility on the continent caſt them at ſuch a diſtance, that for fear of offending ſuch, they avoid the public aſſemblies and ſhun ſtrangers for the ſame cauſe, till they find them void of that ſhameful folly. Hence, as the people freeſt from this vice, and indeed, moſt like themſelves, they love the Engliſh beſt.

§ 18. The town ſtands in an open plane, ſurrounded at a juſt diſtance, with various riſing hills, not cloud-capped mountanes. Theſe at once ſhelter the town, and afford it a moſt pleaſing, diverſified proſpect, over their fertile fields and lawns, of green hills, ſome black heath, and ſome wood. The moſt remarkable of theſe hills, and the neareſt the town, is Louſberg, which is to the northward of it; and as it is not very extenſive, though rather too near, it affords no diſagreeable proſpect; and being aſcended, ſeems but a pleaſing mount, which gives a moſt full and ſatisfactory view of the whole city and her territory. The common ſtone uſed in paving, as well as building, in the city, is a kind of hard grit, of which there are many quarries. But, there are alſo quarries of a beautiful blew, hard marble, ſtriped or vened with white; which ſerves for the better pavements and more ornamented buildings, as well as for lime.

§ 19. The ſoil immediately about the town is, on one ſide, flinty and chalky, to the weſtward; in moſt other places, it is loamy, gravelly or ſandy.

§ 20. The city is furniſhed with water, for the common purpoſes of life, from various ſources. The chief is a ſmall rivulet, conveyed in an open aqueduct from the hills on the ſouth weſt ſide of it, into

into and through the town; where it turns ſome mills, ſerves brewers, deſtillers, fullers, dyers, tanners, &c. for which purpoſes, it runs, in ſome places, in open canals through the ſtreets, in others, in ſewers, that may be occaſionally opened, and damned up, to ſave water, to ſerve in the waſhing of wool, cloaths, &c. to extinguiſh fires and the like. The redundance of this runs to fill their ditches, or to waſh away the ordinary foulneſſes of the town. This is a pretty ſoft, but ill colored water; as it runs from a boggy or moſſy mountane at ſome diſtance. It is therefore uſed for ſome common purpoſes onely.

§ 21. The ſecond ſupply of ſweet water has been ſought and conducted into the city, at a much greater expence, and in a more elegant manner. This is drawn from different ſources, to the north weſt and weſtward ſide of the town. The firſt of theſe is a conſiderable ſpring, which riſes to the north weſt, not far from the town wall, and is conducted by pipes to ſerve public fountanes or conduits, and ſome private houſes in the town. This ſpring riſes on the decline of an hill; it is ſurrounded with kitchen gardens. The ſoil ſeems loamy; the water is very bright, colorleſs, inodorous and inſipid; but depoſites a ſediment of a pale brown, ochry color.

§ 22. A phial, with a ground ſtopple, which weighed	ounces.	2. 5. 0. 5
§ 23. Filled with cold deſtilled water weighed	———	5. 0. 2. 3.
Contained of this water	———	2. 3. 1. 18.
§ 24. The ſame phial, filled with this ſpring water, weighed	———	5. 0. 2. 6½.
§ 25. Contained of the water	———	2. 3. 2. 1½.
§ 26. The difference in weight	———	3½

§ 27. The cauſe of this extraordinary difference is partly owing to the greater coldneſs of the ſpring water, and partly to its greater terreſtreity, the later of which appears,

§ 28. 1. By adding any metalic ſolution, which cauſes a palpable precipitation; particularly,

§ 29. 2. By a ſolution of lead; two drops of this in one ounce of this water, gives a conſiderable milkineſs; four drops makes the liquor white and opac, as milk; and in a few hours, the bottom and ſides of the glaſs become covered with a white precipitate; of which ſome ſmall portion floats in a pellicule on the ſurface.

§ 30. 3. By volatile and fixed alcalies; all which cauſe a conſiderable milkineſs and precipitation; as for example;

§ 31. 4. Ley of tartar; five or ſix drops of this thrown into two ounces of the water, cauſe pale milky clouds, which increaſe as far as fourteen drops. Then, upon ſtanding a few hours, a pale terrene pellicule floats on the ſurface, and a conſiderable, palpable precipitation of the ſame ſubſtance covers the bottom and ſides of the glaſs.

§ 32. Theſe few experiments are ſufficient to ſhew this water to be very far from pure, and therefore, the leſs fit to be uſed in food or medicine; though it is indifferently taken and uſed for the other ſpring, which in all reſpects excedes it, and is really, a light, ſoft, good water.

§ 33. The ſecond ſprings from various ſources ſouthward of the firſt, and more remote from the city. It has been ſought and diſcovered at great expence, where there was none appearance of any ſpring. They dugg ſeveral canals in a piece of ground about a mile diſtant, and conſiderably higher than the city, though lower than the neighbouring grounds; till they diſcovered ſeveral ſmall ouzings or drains of water. When they found theſe to be perrennial ſprings, they united the ſeveral ſources in one current, and conveyed it in an aqueduct compoſed of hollowed ſtones,

joined and cemented together, and covered over with flat ſtones and earth, to the town; where it ſupplies the great fountane near the town-houſe and various others, and furniſhes many private houſes with ſmall branches. This is a much lighter, ſofter and purer water, and better for all the purpoſes of life, than the firſt; as appears by the following, among other analogous experiments, not neceſſary to be mentioned:

§ 34. 1. The ſame phial, in which the firſt was weighed, filled with this water, of the ſame temperature, weighs } ounces 5. 0. 2. 6.

That is, half a grain leſs, than the other, in this ſmall quantity.

§ 35. 2. The metallic ſolutions cauſe but an inconſiderable change in this, compared to the firſt; particularly,

§ 36. 3. The Solution of lead, which gives the other a milky opacity, and cauſes a conſiderable precipitation; in a double proportion, in this, cauſes but a bright pearl-colored milkineſs, and upon ſtanding, hardly gives precipitate enough to obſcure the bottom of the glaſs in which it ſtands.

§ 37. 4. Several drops of alcaline ſpirits and leys make no ſenſible change. For example; fourteen drops of ley of tartar work no perceptible change upon being dropped in; being ſtirred, a very inconſiderable milkineſs enſues; with a very ſlight precipitate and moſt light pellicule, upon ſtanding.

§ 38. To the ſources of pure water, by which Aken is ſupplied, that of Seffen may very properly be added. It lyes within the territories of the city, though not within her walls. It is diſtant about two miles to the north weſt of the town. It ſprings at the head of a beautiful fertile little vale, from a hill compoſed of blew lime ſtone, pebble and flint, and runs from weſt to eaſt. The ſoil all around it is much of the like ſubſtance with the hill, from whence it ſprings, with ſand and chalk in ſome places, ſome marl-pits and

ſome fuller's earth; the laſt of which is a commodity of great importance to a woollen manufacture. The ſpring diſcharges ſuch a quantity of water, as ſerves to turn an over-ſhot corn mill in the valley.

§ 39. 1. This water differs as little from Pfeffer water in weight, as that from deſtilled; which is not half a grane in two ounces and an half.

§ 40. 2. The metallic ſolutions, in conſiderable quantities, work but a ſlight change in it.

§ 41. 3. The alcaline ſalts cauſe no remarkable alteration in it.

§ 42. 4. Sirup of violets is at firſt diluted onely, by mixing with it; but upon ſtanding, inclines to ſome ſhades of a graſs green.

§ 43. 5. In clean bottles, well ſtopped, it keeps, as long as any water. And it is in all reſpects, the pureſt, lighteſt, ſofteſt, ſpring water, I ever examined, except that of Pfeffer, and withal, the coldeſt ſpring, I ever felt, expoſed to the open air.

§ 44. 6. I had of it brought to London and compared it to Briſtol water, after it had been near ſix months in bottles. It appeared as pelucid, but not as grateful, being much ſofter, to the palate. It produced effects analogous to thoſe of Briſtol water in every reſpect, but inconceivably leſs in all the precipitations; from its greater levity and purity.

§ 45. It is no ſmall reproach to the phyſicians, who practice in that country, that this moſt excellent ſpring lyes totally neglected; ſince, it may be uſed to all the moſt noble purpoſes, to which the pureſt water may be applied, internally or externally. Our countrymen need not lament the want of their Briſtol water, while they can get that of Seffen. And, for a ſmall matter, the beſt cold baths may be erected there; the uſe of which would be found extremely ſalutary to many conſtitutions, after being much relaxed by a long and frequent uſe of the warm baths.

§ 46. As the air, and of courſe waters are every where ſenſibly affected by the nature of the ſoil and its products,

ducts, it is proper, in order to inform the reader's judgement aright, to give a ſketch of the chief minerals and vegetables, found in the neighbourhood of Aken.

§ 47. I have already curſorily mentioned ſome of the products of nature in and about theſe territories; the curious, whom I am deſirous, as far as able, to ſatisfy, will demand a clearer and fuller enumeration of them, eſpecially ſuch as tend to our purpoſe.

§ 48. There is a great variety of foſſils, as well as vegetables, in and about the city, of which I ſhall enumerate the principal in order.

SECTION II.

Of the natural Productions of the Soil, in and about the Territories of AKEN.

From a juſt Senſe of the Worth and Probity
Of
The moſt accompliſhed Phyſician,
The moſt generous and facetious Friend,
A French Man born, with a Briton's Heart;
Humbly preſented
To
ANTHONY PETIT,
Doctor-Regent of the Faculty of Phyſic, and Profeſſor of Anatomy and Phyſiology, and of the Theory and Practice of Phyſic and Chirurgery in Paris.

I. *Of* EARTHS.

§ 49. BEſides the common fertile earths of the fields or gardens, there are four other kinds of Earth found here. Theſe are

§ 50. Firſt, Argilla or Clay. Under this head, I comprehend all compact, ponderous, foſſil bodies, ſmooth and ſoft to the touch, when wet, ſeeming unctuous, and, as it were, to diſſolve in the mouth; when dry, abſorbing the humidity of the tongue, and adhering to it, upon contact,

§ 51.

§ 51. With theſe, the territories and all the adjacent countries abound. There are of various colors, and differing in degrees of fineneſs or mixture with ſand.

§ 52. 1. Cimolia alba, of Mathiolus [a], Argilla alba, of Charlton [b], white Argil or Tobacco-pipe clay. This does not diſſolve in acids, or alcaline leys; conſequently, imparts nothing to water.

§ 53. 2. Argilla lutea, cineritia et ſubcoerulea, of moſt writers; yellow, aſh-color and blewiſh clay or loam. This is here, as elſewhere, uſed in making bricks, earthen ware, pots for founders, &c. Theſe are inſoluble as the firſt, more or leſs apt to vitrify, as they contain more or leſs ſand.

§ 54. 3. Cimolia purpuraſcens, of Mathiolus [c]; Smectis terra, Creta Fullonia, of Caeſius [d]; Smectis ſeu terra ſaponaria et Fullonica, of Charlton [e]; Smectis ſeu terra ſaponaria Anglica, of Wormius [f]; Fuller's Earth. This is found of various colors; moſt commonly of an aſh-color, creme-color, and yellowiſh. Its plenty, no doubt, firſt promoted the eſtabliſhment of a woollen manufacture here. It diſſolves in acids with an ebullition; and by this means is capable of impregnating water.

§ 55. Theſe three kinds of earth are looked upon to be void of metallic matter. But, beſides there abounding with the truly terrene principle of metal, the firſt or vitrifiable earth of Becher; the ſecond, undoubtedly contains ſome iron, that of the yellow or lute color eſpecially; which, by calcination becomes red, and by cementation with any fat or oily ſubſtance, gives iron by fuſion.

§ 56. To theſe, ſecondly, the bolar earths are nearly allied, of which there are,

§ 57. 4. Bolus verus, or as moſt writers [g] have it, Bolus vera, orientalis, armena or armeniaca; true oriental or armenian bole. Of this I have found ma-

[a] Comm. in Dioſc. p. 1392. [b] de Foſſil. [c] Book cited. [d] de miner. [e] book cited. [f] Muſ. 4. [g] Authors cited and others.

ny

ny ſpecimens, eſpecially among the rocky places, which were leveled in making the new road to Liege, which anſwer all the characteriſtics of the oriental bole. In many of the by roads and ditches, it is in ſuch plenty, as to color great tracts of ground.

§ 58. 5. Ochra omnium fere authorum; Oker or rather ochre of all the writers; Sil, of Pliny; found in the lead, coal and calamine mines every where.

§ 59. 6. Umbrica vel Umbria Pictorum, Umber or Ombre of the painters; and Creta Umbria of Wormius[a]; from a part of Italy, whence, from its being firſt diſcovered there, or being uſed in the painting of ſhades, it was thus called. This is found near the 5. but not ſo common. Theſe, I look upon to be martial earths, from the deſtruction of Pyrites or other mines of iron; which terminate in bolar or ochrous earths. Theſe want but reſtoring the loſſed phlogiſton to be effectually reduced to iron; as before obſerved of certain argillaceous earths. Theſe are not diſſolved by acids; but ſerve as an effectual medium in the deſtillation of ſea ſalt and nitre; partly from the vitriolic acid, with which they are imbued. Of this, the red or bole has the moſt, the yellow or ochre, leſs, and the brown or umbre, the leſt. The third kind of earth is,

§ 60. 7. Marga, of all the natulariſts; Marle. This is a ſubſtance of a middle conſiſtence between Clay and Chalk. It is lighter, leſs compact and coherent, of courſe more friable, than clay, and does not feel ſo fat or unctuous; it is not ſo firm or uniform as chalk. Of this, writers enumerate various kinds of different colors. Here, I have onely obſerved the aſh-colored or white. It is ſeen in every valley or at the foot of every conſiderable hill. It ſeems to conſiſt of ſhells of ſnails and other ſuch like animals; of which ſome diſtinct portions are ſometimes viſible in it, before it be much mixed or broken. It is a pure abſorbent earth, diſſolves in all acids with

[a] Muſ.

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an ebullition, ſweetens them, and may yield a kind of neuter ſalt. Hence, it is eaſy to conceive how waters may be charged with this and ſuch like earths.

The fourth kind of earth is,

§ 61. 8. Creta, of all the authors, Chalk. The moſt conſiſtent and emplaſtic earth, not ſoft or unctuous upon feeling as Clay, but more drying, and apt to abſorbe the moiſture of the tongue and adhere to it upon contact. This is found in divers places to the weſtward of the town. It diſſolves in all acids, blunts their acidity or ſaturates them; ſo that, by their means, water may be impregnated with it.

Under this head, may be comprehended, the ſubtil calcarious earth, found aflote in, and upon, the ſurface of the Thermal waters; known to Kundman, under the name of Flos calcis; to Hoffman, under that of Cremor thermis ſupernatans; and to Wallerius, by that of Calx nativa aquis ſupernatans vel mixta.

II. Of STONES.

§ 62. 1. Arena, ſand, of all authors. Of this there is great plenty all about the town; but chiefly to the north and ſouthweſt. It is found as fine as any ſeen on the ſea coaſts, and in layers of all colors, from a bright white, to various ſhades of yellow, brown and bole-color. Where the ſurface of the ſand hills have not for a long time been broken, there are large quantities of ſea ſhells of different kinds, chiefly bivalve, found partly unchanged, and partly, but moſtly, petrified. So that however remote this may now be from the ſea, it may juſtly be looked upon as the Arena Marina or littoralis of the naturaliſts; and it will not be wondered at, that an efflorescence of pure ſea ſalt is found on the walls, built or plaſtered with this ſand; eſpecially about the baths, whoſe waters are charged with the ſame ſalt.

§ 63. The Philoſophers about Aken, which are chiefly the clergy, would attribute all the phaenome-

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na relating to this production of ſand, petrifications, and the whole remarkable hill, called Louſberg, to the univerſal deluge. That it bears ſome marks of water, is not to be denied; yea, that the top of the higheſt hill there muſt have been long overwhelmed with water, and that of the ſea too, is more than probable, from the ſhells of ſea fiſhes, the bones and teeth of fiſhes found on their loftieſt ſummits. But, whether or not, theſe be effects of the Moſaic deluge, or what other has produced them, I leave to more accurate natural philoſophers and hiſtorians. And ſhall content my ſelf with onely obſerving, that though theſe hills bear theſe evident marks of having ſometime layen under ſalt water; they at preſent bear more evident ſigns of ſubterranean fire. I take Louſberg for a moſt particular proof of this: It's ſurface is made up of hillocks and hollows. In theſe, are found many ſtones, that bear the marks of fire, as well as complete cinders of coal. With theſe, pieces of very large horns of the deer kind are found; with which the apothecaries of the city do not heſitate at ſerving the preſcriptions of thoſe vane practicioners, who, where ounces of any ſuch calx could anſwer no deſireable purpoſe, rely on ſome few granes of hart's horn philoſophically calcined, as it is called, when reduced to this form by boiling water. Moreover, at the bottom of the hill, in the ſand pits, pieces of metallic ſtones, or iron ores of different ſizes, and of ſuch forms, as thoſe like bodies, fuſed and caſt in looſe ſand, may be ſuppoſed to put on, are found in great plenty. Theſe ſand hills, as well as the heat and compoſition of the Baths, muſt, in my judgement, owe their origine alike to ſubterranean fire; which, by the ſudden rarefaction and violent expanſion of a ſmall quantity of confined water, is capable of producing Earthquakes and ſuch like convulſions, as may level hills, and raiſe valleys into mountanes. Whoever examines the top, ſides and bottom of Louſberg, with due care and attention, will, in mine apprehenſion, find many

marks

marks of a volcano upon it. And it will not be wondered, that in the laſt century, Aken and it's territories felt ſuch a ſhock of an earth-quake, as diſturbed the ſources of their ſweet waters.

§ 64. 2. Lapis arenoſus, et Saxum arenarium of Aldrovandus [a], Wormius [b], Charlton [c], &c. The Sand-ſtone or Free Stone. Of this, there are two kinds; one of a brown color, as if it were ſand looſely connected together, or a grit ſtone decayed; what is known in Ireland, by the name of Rotten ſtone. The other, compoſed partly of a yellowiſh ſand, looſely connected with ſmall ſhining ſcales like Selenite or Talc, which is the true Free ſtone.

To theſe may be added,

§ 65. 3. Lapis arenoſus, lateritii fere coloris, Haram porcinam redolens. I found ſome ſpecimens of this ſtone, which I have not ſeen any where deſcribed, about Louſberg. It is of a pale brick-color, of a looſe, light texture, or kind of ſandy conſiſtency, and being rubbed, ſmells ſtrongly like a foul Hog-ſtie.

a. Thrown upon burning coals, it neither fumes nor ſmells ſenſibly; projected into an ignited crucible, none other effect is produced; but, by calcination, it gives lime.

b. In the vegetable, as well as mineral acids, it cauſes a ſtrong and long continued ebullition; with the vitriolic, an intolerable fetid ſmell and ſubtil white vapor, offenſive to the noſe and lungs.

c. Infuſed and even boiled in alcaline leys, it gives no remarkable ſmell nor color; nor does this tinge ſilver; but, with the ley thus digeſted, acids produce the ſame intolerable ſmell and vapor, as with the crude ſtone.

Is this the Lapis ſuillus, Swine-ſtone of WALLERIUS [d]?

§ 66. 4. Lapis hibernicus; Lapis fiſſilis hibernicus;

[a] Muſ. Metalic. [b c] Books cited. [d] Mineralogy p. 121. and § 9.

Tegula

Tegula vel Ardeſia hibernica, of Meret [a], Charlton [b], Fuller [c], &c. In the coal mines, and about Spa, plentifully. It contains iron and the vitriolic acid, with which it impregnates water. Hence, the waters in the coal mines are all ferugineous and depoſite ochre in their canals.

§ 67. 5. Lapis ſciſſilis et cruſtoſus, of Meret [d]; Ardeſia or Hardeſia of moſt writers; Slates. In all the mountanes.

§ 68. Beſides common Grit and various Whetſtones, and Hones, there are,

§ 69. 6. Lapis calcarius, or ſaxum calcarium; the common grey lime ſtone, of moſt authors.

§ 70. 7. Marmor ſolidum, durum, coeruleum venis albis variegatum; a ponderous, hard, blew marble, vened with white; Which ſerves for the better pavements, more elegant ſtone buildings and for lime. Theſe are partly ſoluble in acids.

§ 71. 8. Lapis Geodes, of Mathiolus and Wormius [e]; Geodes of our Woodward and others. The baſtard Eagle-ſtone. In the Sand Pits at the foot of Louſberg, of various ſizes and forms. It ſeems to be a deſtroyed Iron Ore; of which there are various kinds and great plenty of all ſides of the territories.

III. Of METALLIC MINERALS.

§ 72. 1. Cadmia foſſilis, alias Lapis Calaminaris of moſt naturaliſts; Cadmy, Calamy or Calamine ſtone. The mine of that imperfect, but uſeful metal, Zinc, or Spelter. With this, the Territories, as well as the Dutchy of Limburg, abound, ſo far, as to furni ſhſeveral very conſiderable braſs Foundaries. Of theſe, one was formerly eſtabliſhed in Aken; but it is now tranſplanted to Stolberg, a village about a league from the town; partly, for the greater con-

[a] Rerum natur. Britan. Pin. [b] Book cited. [c] Pharmac.
[d] Book cited. [e] Books cited.

venience

venience of water, as well as firing. This is ſo rich, as to give from fourteen to twenty pounds, and upwards, increaſe upon the hundred weight of copper, in converting it into braſs.

§ 73. 2. Lapis Pyrites, or Pyrites, of Mathiolus, and of all the other Latin, as well as Greek writers; Pyrita, improperly, of ſome; Marchaſita of the Arabians, and of ſome moderns. Sulphur ferro mineraliſatum, minera difformi, pallide flava, nitente. Pyrites ſulphureus rudis. Pyromachus veletum. Of WALLERIUS[a]. The Pyrite or Fire-ſtone; either from its ſtriking fire with ſteel like a flint, or from its contracting heat and ſometimes actual fire, above, as well as under, ground. Of theſe, great plenty are found all about the neighbourhood, and in the quarries and in digging vaults in the ſtreets of the town. Theſe contain every metal that is found mineraliſed with ſulphur: I have had ſome ſpecimens given me, as the product of the vicinage, that contained copper and ſilver. Of the later kind, there is plenty at Prayon, near Chaudfontaine, in the Ligeois; a martial pyrite interſperſed with galena. But, thoſe, I ſaw taken up about Aken, contained but a little Iron and much ſulphur; and ſeemed to me to be but of the two kinds diſtinguiſhed, 1. Globuli pyritacei pallide flavi. 2. Globuli pyritacei nigricantes. Minera martis ſolaris Haſſia, by WALLERIUS[b]. From the Pyrite at Prayon, they extract ſilver, ſulphur and martial vitriol; but, can not work it, except in winter, from the violent heat, the Pyrites contract in the mine. To theſe, the heat and the other principal qualities of cold, as well as hot, mineral waters, will be found owing. The Pyrite, in heating, is decompoſed; the phlogiſton flies off, and its other conſtituent, the univerſal acid, diſſolves the metallic ore. Waters, paſſing through ſuch heated and diſſolved minerals, muſt be heated, as well as impregnated with their ſoluble contents; and, if they be not too far

[a] Mineralogy, p. 379. [b] Mineralogy, p. 233.

from

from the ſurface of the earth, muſt come forth thus heated and impregnated. If they be too remote, and have time to cool, before they ſpring forth, they will give cold, chalybeate or ferrugineous waters. If they paſs by or over ſuch minerals, without waſhing them, they may be heated as above, and charged or not charged with the more volatile parts, that are continually eſcaping; ſuch as the phlogiſton and ſome volatiliſed and ſubtiliſed acid; and thus the production of ſimple or medicated natural baths are eaſily and rationally conceived. See § 359, 360. to § 380.

§ 74. 3. When I have demonſtrated Pyrite, it is eaſy to conceive, that the Sory, Chalcitis, Miſy and Melanteria of the antients, vitriols in ſo many different forms, cannot be wanting.

§ 75. 4. Galena, or lead ores, of moſt authors, found in the neighbourhood of Aken to the weſtward, the names of the places, to me, unknown.

IV. *Of* BITUMINOUS *and* SULPHUREOUS BODIES.

§ 76. 1. Lithanthrax, ſeu Carbo foſſilis, of all authors; pit, ſtone or foſſil coal. Of this, there is great plenty and variety about Leige, the dutchy of Juliers, and the territories of Aken. The former is a pitchy coal, of a lax and fragile texture. Theſe burn quick and flame much. The common people knead them into cakes, with one third or one half common loam, and water, and then dry them; when they make a ſtrong and laſting fewel. The Aken coal is more compact and dry, and burns ſlowly; fumes and flames but little. It is not ſo fit for ſmiths and founders, as the others. But ſerves well for all the common purpoſes.

§ 77. 2. Sulphur foſſile ſeu vivum & nativum, of Wormius[a]; common mineral ſulphur, or native brimſtone. Many of the pyrites, thoſe of Prayon eſpecially, are ſo rich in ſulphur, as to afford it without the help

[a] Muſ. 26.

of

of fire. But, not onely theſe, but all the others yield it by fuſion, ſublimation or a kind of deſtillation by deſcent. Beſides, the vapor of the baths of Aken, as well as the lower ſprings at Borſet, yield plenty of the pureſt ſulphur, in a manner hitherto falſely looked upon as a ſublimation; but which ſhall be ſet in a different light and explaned in its place.

§ 78. To remove all room for doubt, and to avoid that ambiguity, into which, moſt writers on medicated waters run; I here ſet down what chemiſts and naturaliſts underſtand by ſulphur, and what I mean, wherever I uſe the word.

§ 79. Sulphur is a mineral concrete, of a peculiar ſmell; to taſte, almoſt inſipid. When pure and ſimple, always of a pale yellow; but, changing into various ſhades of thisand other colors, upon combination with different minerals and metallics. In the concrete form, it is not quite opac; it is harder than reſin, more compact and heavy; but breaks in ſtriae, like little packets of cryſtalliſed ſalts. The more ſubtilly it is divided, the more colorleſs and white it appears. Thus, its magiſtery, made by diſſolving it in water, by the means of alcalies, and precipitating it with acids, is of a pale white. It requires an heat ſome degrees above that of boiling water to melt it; when melted, it appears a tranſparent liquor of a rediſh color; but, upon cooling, changes to its priſtine, pale yellow color, and becomes almoſt opac again; upon breaking the concrete, it ſhews itſelf compoſed of little bundles of ſhining needles, like cryſtalliſed ſalts. While it fuſes, a ſubtil vapor conſtantly flies off, which is offenſive to the noſe and lungs. This vapor collected in any fit veſſel, condenſes in form of a mealy powder, called flowers of ſulphur; theſe are compoſed of minute cryſtals of the ſulphur, whoſe color and qualities it poſſeſſes. The whole ſulphur ſublimes in this form, in which it ſuffers no change, but comminution; for, by fuſion, it is reduced to its original form and conſiſtency. It is extremely inflammable; ſo as to catch fire

from a ſpark; whence, it makes a principal part in the compoſition of gun powder. Sulphur ſet on fire burns ſlowly and calmly; gives a blew flame, without any ſoot or ſmoak; but, a white vapor flies off, as it burns, which offends the eyes and noſe, and is intollerable to the lungs. It is hard to extinguiſh its flame, when once it is ſet on fire. The vapors or fumes of burning ſulphur, being collected in fit glaſſes, condenſe into an heavy, acid liquor, with all the properties of that found in vitriol, alum, &c. This ſhews the conſtituent parts of ſulphur to be the univerſal acid and the inflammable principle; and the proportions appear to be about fiveteen parts of the acid to one of the phlogiſton. That ſulphur conſiſts of theſe parts, is alſo proved by the artificial generation of ſulphur; which is produced by fuſing any neuter ſalt, compoſed with the vitriolic acid, and throwing into it any inflammable body; the reſult of which will be a dark colored maſs, which partly diſſolves in water; gives a fetid ſmell and a yellow tincture, which is precipitated with acids, in the form of a magiſtery; which, fuſed, gives perfect ſulphur. See the general idea of ſalts, § 52. and the trial and choice of ſimple waters, § 196.

§ 80. Sulphur is ſoluble in oils, by the motion of heat; eaſily and in larger quantities in the liquid bitumens or mineral oils, and in the more groſs and viſcid, the expreſſed vegetable oils; more hardly and in leſs quantities in the more light and ſubtil, the eſſential or deſtilled oils; to all which, it gives a dark red color, and thick conſiſtence, in proportion to the degree of impregnation.

§ 81. Sulphur is not ſoluble in any acid;
in burning ſpirits; nor
in water.

§ 82. Sulphur unites with all metals and ſemimetals by fuſion; with this they are all generally found mineraliſed; except gold.

§ 83. Sulphur with two parts of a fixed alcali fuſe together into a liver colored, fetid maſs; which is capable of diſſolving all the metals gold not excepted.

This

This maſs, which is called liver of ſulphur, 1. runs or liquefies in the air, is of a muddy dark color and nauſeous ſmell and taſte. 2. It diſſolves in alcohol, and gives an orange colored tincture. 3. It diſſolves in water, and gives it an high yellow color. 4. If acids be added, theſe ſolutions are deſtroyed; they grow firſt milky and more fetid, and, as faſt as the alcali is ſaturated, the ſulphur is precipitated in the form of a white magiſtery; which, being waſhed with fair water and dried, gives the preparation of this mineral, called milk, magiſtery or precipitate of ſulphur. It is but ſulphur in a more ſubtil ſtate of diviſion: For, by fuſion, it is reſtored to its original form and conſiſtency.

§ 84. Sulphur alſo diſſolves by boiling in alcaline leys or lime water; and by acids, the ſolution is deſtroyed, and the ſame precipitation as above produced.

§ 85. Sulphur being mixed with ſalt ammoniac and quick lime, by deſtillation yields a pungent, fetid liquor, of an high red color, which fumes perpetually. This liquor, or theſe fumes turn ſolutions of lead black. Saturated with acids, it yields a precipitate of ſulphur.

§ 86. Theſe ſolutions of ſulphur tinge ſilver, firſt yellow, or of a gold color, and ſoon after tarniſh it red, blew, purple and black. Their vapor produces the ſame effect, but more ſlowly. And water, with ſuch impregnated, precipitates the mercurial or white metals, of different ſhades of yellow or brown, according to the degree and ſubtility of the impregnation.

§ 87. Theſe are ſome of the principal diſtinguiſhing characteriſtics and properties of ſulphur, which in our language is called brimſtone; and no ſubſtance, in which theſe do not agree and meet, is to be called or deemed ſulphur, without falſhood and confuſion.

V. *Of the Vegetables in and about* AKEN.

§ 88. To enumerate theſe would ſwell this work beyond the intended ſcope: For, no inland place in Europe can be ſuppoſed to afford greater variety of trees, ſhrubs and other plants, from the variety of ſoil in and about the territories of this city. I ſhall therefore touch but curſorily on this branch of its natural hiſtory; pointing out onely ſome of the moſt curious or rare plants, or ſuch as work a ſenſible change in the neighbouring air.

§ 89. The woods are here not onely compoſed of foreſt or timber trees, as well as underwood, of moſt kinds, that are ſeen in Britain, but are alſo ſtocked with various fruit trees; ſuch as the wilding, the medlar, the common plumb, the common red and black cherries, in great abundance; to theſe let me add,

§ 90. 1. Juniperus vulgaris fruticoſa, C. B. P[a]. The common juniper ſhrub of Caſpar Bauhine's pinax, whoſe berries are ſo uſeful in medicine and in medicating fermented or burning ſpirits. In all the mountanes, in great abundance.

§ 91. 2. Roſa ſylveſtris foliis odoratis C. B. P. The ſweet Briar. In coppices and hedges.

§ 92. 3. Groſſularia vulgaris recentiorum; the common yellow, ſmooth gooſe-berry of the moderns; ſpontaneouſly in the rudeſt mountains. Vaſt plenty in the valley of Malmendy.

§ 93. 4. Vitis Idaea foliis ſubrotundis exalbidis, C. B. P. The great Whortle or Billberry, with leaves almoſt round and whitiſh, of Bauhine. In all the rude, ſhrubby mountanes between Aken and Spa and about Malmendy and Stavelot. I found it with the Vitis Idaea foliis oblongis crenatis, fructu nigricante, C. B. P. the common whorts, whortle-berries or bill-berries, in moſt places.

[a] Caſpari Bauhini Pinax Theatri Botanici.

§ 94.

§ 94. 5. Vitis Idaea foliis oblongis albicantibus, C. B. P. The bill-berry with oblong and whitiſh leaves and very large berries. With the former.

§ 95. 6. Vitis Idaea foliis ſubrotundis non crenatis, fructu rubro, C. B. P. The red bill-berry. With the preceding, very common.

§ 96. 7. Cornus hortenſis mas C. B. P. The Cornelian cherry. In woods and coppices, and planted for hedges in gardens; as at that of the Capucin friars in Spa. The fruit is kept in preſerves and conſerves.

§ 97. 8. Berberis dumetorum, C. B. P. The Berberry or Barberry. In moſt woods and ſhrubs.

§ 98. 9. Sambucus racemoſa rubra, C. B. P. The red berried elder. I firſt obſerved this tree and admired its beauty in the woods about Spa, particularly near the fountain of Geronſter. It is much leſs fetid, than the common; its leaves are more elegantly indented, its flowers not in umbels, and of a pale yellow, not a white color, and its berries hang in fair ſcarlet, grape-formed cluſters. I afterwards ſaw it in many other places of the neighbourhood, in wet woods chiefly.

§ 99. 10. Sambucus humilis ſive ebulus, C. B. P. Dwarf elder. This is improperly ranked by all the authors with trees and ſhrubs; but moſt improperly; as this has nothing woody about it; the whole plant dying to the root every autumn.

§ 100. 11. Rubus Idaeus ſpinoſus, C. B. P. The common red raſp-berry. In all the woods.

§ 101. 12. Rubus Idaeus fructu albo, C. B. P. The white raſp-berry. With the preceding.

§ 102. Theſe are all the trees and ſhrubs, that occurred to me in ſeveral perambulations of moſt places in this part of the country, which I judged rare or remarkable. I muſt have overlooked many for want of time and aſſiſtance; and I choſe for brevity to omit all ſuch as are commonly found in the like ſoil among us. I have ſet them down irregularly, nearly as they accidentally occurred to me; except where I ſet down one with ano-

ther on examining them. I now procede in the ſame manner to enumerate ſuch of the herbs or more tender and leſs durable plants; of which, I muſt, for the above, among many other, reaſons, overlook or omit an extreme variety; eſpecially of the early minute vernal plants, particularly of the fungus or muſhroom kind; of theſe, I ſhall mention onely the durable.

§ 103. 13. Fungus membranaceus auriculam referens ſive ſambucinus, C. B. P. Jews ears. About the roots of old decaying trees of all kinds, as well as the elder, in moiſt places.

§ 104. 14. To this claſs ſeems to belong a ſingular production, found upon the ſtone, that covers a little hot ſpring and reſervoir in St. Cornelius's bath, in Aken. Theſe were membranaceous, fungous ſubſtances, of a ſort of gelatinous conſiſtency, growing upon the ſtone, which was blackened with the ſulphur of the waters. When there is no demand for the water, the ſource and reſervoir fill up till the water touches this ſtone; but when it is drawn, the ſtone lyes clear of it. Upon this blackened ſtone, theſe ſubſtances were produced, which were notwithſtanding more tranſparent and leſs colored, than the ordinary Jews-ears, as they were much more watery; for being dried, they came to near the ſame color and conſiſtency with the Jews ears; but, loſſed more in proportion of their weight by drying. In deſtillation and burning, both yielded the like products and appearances; whence, I think them nearly related, and therefore call this, Fungus membranaceus, ſeu gelatinoſus Thermarum; the gelatinous, bath Fungus, reſembling Jews-ears.

§ 105. 15. Agaricus ſive fungus laricis, C. B. P. The Agaric or fungus of the larch tree. I have not found this fungus on this tree; of which I ſaw none ſpontaneouſly growing in this part of Germany; but, one, that greatly reſembles it in color and form, of a more tenaceous and corky texture, is ſeen upon all old birch trees in the foreſts.

§ 106. 16. Fungus noxius 3 ſive in caudicibus naſcens unguis equini figura, C. B. P. This is found in all the great foreſts upon moſt trees. When it is found on the oak, it is the ſtyptic come lately into uſe among the French chirurgeons. The paiſants of Germany uſe it as tinder; for which they prepare it either by beating with mallets, till it becomes ſpongy and ſoft, when it is fit for the purpoſes of chirurgery; or by boiling in leys of wood aſhes, when it requires leſs beating, the more tenacious and glutinous parts being diſſolved by the ley, leaving onely the light fibres behind; which, being dried, are very combuſtible, and are by ſome rendered more ſo, by dipping in a ſolution of ſalt petre, and afterwards drying them.

§ 107. 17. Muſcus filicinus major, C. B. P. Fern moſs. In ſhady wet woods and rocky places.

§ 108. 18. Alga in tubulis aquam fontanam deducentibus, C. B. P. Conferva rivulorum capillacea denſiſſime congeſtis ramulis, RAII [a]. A very minute capillary plant, as fine as the pile of velvet. In the aqueducts and fountanes of ſweet waters in the city, and in ſprings and rivulets about the country. In the ſtagnant waters, this little plant paſſes unobſerved with the mud, on which it grows and lyes; till growing to maturity in the warmer months, it riſes, carries its mother mud with it, and buoys it a while on the ſurface of the water. I am not able to diſcover any eſſential difference betwixt this and the conferva fontalis fuſca omnium minima mollis, of the ſame author. I believe, they will be found to differ chiefly from the place of growth; and that this and the conferva gelatinoſa omnium tenerrima et minima, aquarum limo innaſcens are but accidental diverſifications of the ſame plant. The diſtinguiſhing characteriſtics are undoubtedly, not eaſily aſcertained. They are found in all the ſimple waters about the town and country, and

[a] Synopſ. method. ſtirpium Brit. Ed. iii. p. 58.

in the warmer months of ſpring and autumn, they are obſervable aflote on the ſtagnant waters; where they never were ſuſpected, much leſs taken, to be ſulphur, or a bituminous matter, as they, or ſome of them, have been time immemorial, by the writers and practicioners at our Bath in Somerſetſhire, and preſcribed as ſuch, before I firſt publicly aſſerted and demonſtrated the contrary, and ſhewed the ſhameful miſtake, in the year 1753. If theſe, or any of them, were ſulphur or bitumen, it does not follow, that the water, on which it is found floting, ſhould be ſulphureous or bituminous; becauſe ſimple, pure water is not capable of diſſolving either, without the interpoſition of ſome proper ſalt. Therefore, it would be but rediculouſly abſurd to call a water ſulphureous or bituminous, for finding theſe matters aflote on it, ſuppoſing them ſuch; without ſome proof of a ſolution or impregnation. How much more ſhamefully abſurd is it, to look upon actual vegetables, as ſulphur or bitumen, and to denominate waters ſulphureous or bituminous from their producing or containing theſe little, light, minute weeds? If every water be to be deemed ſulphureous, for ſhewing theſe in its ſource, on its bottom, mud or ſurface, at certain ſeaſons of the year, I ſhould be deſirous to ſee water, that is not, or by lying in open air, does not become in this ſenſe, ſulphureous. But, of this more in its place.

§ 109. 19. Muſcus terreſtris repens ſive clavatus, C. B. P. Club moſs or Wolf's paw. In all the high, heathy mountanes, eſpecially near Spa.

§ 110. 20. Lichen petraeus latifolius ſive hepatica fontana, C. B. P. Green or fountane liver-wort. I do not ſo much offer this as a rare plant, which grows in all moiſt places about ſprings and rivulets, here as well as with us; as to ſhew the diſpoſition of ſome parts of the town to humidity. I firſt obſerved it on the walks of a little garden behind the houſe of M. Neven, the apothecary, not far from one of the ditches of the inward town wall; but, I afterwards found it in all ſuch ſitu-

ſituations; where the place lay near the water and was ſhaded from the ſun.

§ 111. 21. Polypodium vulgare, C. B. P. Common pollypody; here, as well as with us, not onely in the woods and mountanes every where; but alſo on the old walls, thoſe of the town, in ſome places.

§ 112. 22. Aſplenium ſive ſcolopendria, ceterach officinarum, C. B. P. Spleen wort. On the walls.

§ 113. 23. Trichomanes ſive polytrichium officinarum, C. B. P. Common Engliſh black maiden hair. I do not mention this more than ſome others, as in themſelves rare, ſo much as for the ſingularity of their production, on all the old ſtone walls in and about the town. This I obſerved alſo larger, than I ever found it before, at the foot of an old hedge by the high way leading to Spa from the weſt ſide of the town; there, I found it plentifully, each plant or leaf from ten to eleven inches in length.

§ 114. 24. Adianthum album of moſt botaniſts; Ruta muraria, C. B. P. White maiden-hair or wall rue in plenty on the town walls.

§ 115. 25. Filix ramoſa non dentata florida, C. B. P. Flowering fern or Oſmund Royal. In wet woods and mountanes.

§ 116. 26. Eryſimum Theophraſti folio hederaceo, C. B. P. Fagotriticum, I. B[a]. Buck wheat, ſown in the moſt barren fields, and uſed as bread corn by the paiſants.

§ 117. 27. Biſtorta radice minus intorta, C. B. P. The greater Biſtort of the ſhops. In rich, moiſt ſoil, in ſhady places, and on the banks of rivulets.

§ 118. 28. Jacobaea alpina laciniata, flore buphthalmi, C. B. P. Great broad leaved Ragwort; in all the moiſt woody places, to four or five feet high, its ſtalk round and ſmooth, of a dark green and near the tops purple; its leaves like thoſe of the Chaſtenut.

[a] Johan. Bauhini Hiſt. plant.

§ 119.

§ 119. 29. Carlina acaulos magno flore, C. B. P. The low or ſtalkleſs Carline thiſtle. In all the barren dry paſture, and by the high ways.

§ 120. 30. Eryngium vulgare et Camerarii; C. B. P. Common Eryngo. About the high ways, eſpecially in ſandy places, particularly between Aken and Maeſtrecht.

§ 121. 31. Meum foliis Anethi, C. B. P. Meu or Spignel. In wet, courſe meadows and in deep ſoil, by rivulets and ſprings, eſpecially towards Spa, Malmendy and Liege.

§ 122. 32. Polygonatum latifolium vulgare, C. B P. Solomon's Seal. In moſt woods and ſhrubby places.

§ 123. 33. Lilium convallium album, C. B. P. May Lilly, or Lilly of the Valley. In dry ſhady places.

§ 124. 34. Vitis idaea paluſtris, C. B. P. Marſh whorts; Moſs or Moor-berries, in Ireland bog-berries. In all the wet, moſſy mountanes.

§ 125. 35. Gentiana major lutea, C. B. P. Common Gentian of the ſhops. In company with Doctors Leſoinne and Gilliaumes towards the dutchy of Limburg in open paſtures.

§ 126. 36. Lyſimachia chamaenerion dicta latifolia, C. B. P. Roſebay-willow weed. In the margines of fields and meads; eſpecially towards Spa and Malmendy.

§ 127. 37. Lyſimachia lutea major, quae Dioſcoridis, C. B. P. The great yellow looſe ſtrife or willow-weed. In moiſt woody places, near ponds or rivulets, with the Lyſimachia ſpicata purpurea fortè Plinii, of the ſame author, but not ſo common.

§ 128. 38. Viola bicolor arvenſis, C. B. P. The common panſies or two faces under an hood. I do not mention this as a rare plant. But, becauſe I find it looked upon by the miners as a mark of calamine. I obſerved it plentifully in the territories, in the dutchy of Limburg, where that mineral abounds, and at Stolberg, where it is much uſed. But, why or whether

or

or not it be an indication of this mine, I can not pretend to determine.

§ 129. 39. Aſclepias flore albo, C. B. P. Swallow-wort. In the hedges and ſhrubs, chiefly about Spa.

§ 130. 40. Clematis daphnoides minor, C. B. P. Periwinkle. Near Franchimont firſt, and then among the copice in ſeveral places.

§ 131. 41. Verbaſcum Lychnites flore albo parvo, C. B. P. Small white flowered Mullein. With the great yellow Mullein upon dry banks north weſt of the town.

§ 132. 42. Colchicum commune, C. B. P. Meadow Saffron. In all the meadows in great plenty, in autumn.

§ 133. 43. Balſamina lutea, ſive noli me tangere, C. B. P. Quick in hand, or touch me not. I firſt obſerved it about the Geronſter at Spa; afterwards at Chaud-fontaine and Aken, in moiſt, woody and ſhady places.

§ 134. 44. Campanula vulgatior foliis urticae vel major et aſperior, C. B. P. Nettle-leaved or great Throatwort or Canterbury Bells. In the ſhrubs about Frankenberg, near Aken, copiouſly.

§ 135. As attempting a complete natural hiſtory, is foregne to my ſcope, and purpoſe; I muſt leave every naturaliſt to judge from this ſpecimen, how this tract muſt be ſtocked with the more common vegetables. I know no country better furniſhed, with fit herbage for beef or mutton, roots and nuts of various kind for ſwine, as well as an immenſe variety of medicinal ſimples; ſo that bountiful nature has no where better provided for the nurture and health of its inhabitants, than at Aken.

§ 136. From the ſituation of the city, the nature and products of the ſoil and waters in and about it, the quality of the air may in ſome meaſure be judged. It is then found temperate, mild, clear, and wholeſome; and the town is as remarkable for the health and longaevity of its inhabitants, as any, in the like latitude, upon the continent.

§ 137.

§ 137. But, there are other circumſtances to be brought into this eſtimate; in order to form a ſound judgment of the nature and quality of the air; the fewel commonly uſed and the vapor conſtantly diſcharged from the baths.

§ 138. As for the firſt, the city is furniſhed very plentifully with moſt excellent mineral coal. Of which there are ſeveral rich mines in the neighbourhood; but that, which is principally uſed in the city, is raiſed in the north eaſt part of her territories, about three miles diſtant from the town. It is a compact, cloſe-grained, ponderous coal; and, according to our modern notions in natural hiſtory, of foſſil coal, being but wood mineraliſed, this would ſeem to be oak. It makes a very hot and durable fire, with little or no ſmoke; in which, it approaches near to the nature of the Kilkenny coal, in Ireland. There is another kind of coal found in great plenty near Stolberg; where there is a very conſiderable manufacture of braſs, in the territories of the elector Palatine, not far from thoſe of Aken. This coal is leſs ſolid and ponderous, and more bituminous. It was formerly much uſed at Aken, before the braſs works were removed to Stolberg; but, now the conſumption of it is but inconſiderable among a few ſmiths and founders.

§ 139. The air then, is but little altered from this quarter. What change is wrought in it by the mineral waters or baths, we ſhall have occaſion to explane in the ſequel. In general, there is room to judge, the air is moiſt: For, all the bare walls, whether brick or ſtone, bring forth great plenty of vegetables; not onely of the capillary tribe, but others, that require more moiſture. And the walks of little gardens, which are not much trodden, are ſoon covered over with Moſs and Lichen. This is found chiefly in places near the ditches, and in a northern expoſure, or cloſe built. The judicious, in ſettling their lodgings or other habitations in this city, may draw ſome uſeful practical and oeconomical hints from theſe obſervations.

SECTION

SECTION III.

A particular Deſcription of the Baths and their Sources; with an analytical Enquiry into the Nature and Qualities of the Thermal Waters of AKEN.

With all Affection and Duty,
Preſented to
The moſt learned and reſpectable,
The Dean,
Doctors and Profeſſors
Of
The Faculty of Phyſic,
In the Univerſity of Rheims;
And
The Dean,
Doctors and Profeſſors
Of
The Faculty of Phyſic,
In the Univerſity of Leyden,
Where the Author was honored
With
The Degrees in Phyſic.

I. *A Deſcription of the Baths and Sources.*

§ 140. BY what the Greek Phyſicians knew under the name of Θερμαι, from θερμη, heat; the Latins, by an appellation borrowed from the greek, Ther-

Thermae, or that of Balneum or Balineum, which we have rendered, Baths in our tongue; we underſtand any ſource or ſpring of water, iſſuing from, or found in, any part of, the earth, of a temperature any degree warmer, than the atmoſphere in ſummer.

§ 141. Of theſe, there are many and great varieties in almoſt every part of the world; differing in degrees of heat, and according as they are more or leſs impregnated with different minerals. Some are found pure, as any ſpring, of different degrees of heat; as one in Iceland, whoſe heat nearly equals that of boiling water; yet, in nothing elſe differs from common water. Thoſe of Pfeffer, &c. before mentioned; not quite ſo hot, as that of Iceland; but, pure as rain or ſnow water. Some in Italy, of equal heat, but leſs pure; and others in different parts of Germany, Hungary, Italy, Spain, Portugal, France, Britain and Ireland, impregnated with different mineral bodies; ſuch as various ſalts, earths, metals and metallic bodies, and ſulphur, eſſentially, if not ſubſtantially.

§ 142. Among this boundleſs variety, I purpoſe, in due time and place, if not anticipated by ſome abler hand, to treat of ſuch as the practicioners or people in theſe kingdoms are intereſted in knowing; as far as they have fallen, or hereafter may fall, under mine obſervation; giving preference, where I find it moſt due, to the baths of Aken, in French, Aix la chapelle.

§ 143. 1. In this city, juſtly celebrated for its baths, there are ſeveral ſources of naturally hot water. The principal ſource riſes in a little valley eaſtward of the town houſe, and northward of the great church, and runs towards the north. The whole ſpring is incloſed by a ſtrong ciſtern, made, as I am informed, of hewn ſtone, as far as the water riſes, the reſt of brick and mortar. This ciſtern is of a ſquare form, which meaſures, one way, ſeven feet, three inches; another, ſix feet three inches, and in depth, nine feet. Towards the upper part, it inclines to a vault,

vault; till the dimenſions are contracted to an opening, of about three feet and an half, by two feet and an half; to which, one of the porous ſtones, brought from Saint Malos, and uſed for the moulds for caſting plate braſs, at the braſs founderies at Stolberg, is adapted, as a cover, with hinges, bars and locks and keys. This is, and is called, the Great Source. It is here, the moſt curious and extraordinary collection of ſulphur is made: For, wherever the vapor of this water is confined, for a certain time; there, a moſt remarkable concretion of the pureſt ſulphur is formed. All the brick work and ſtone cover of the dome or ſuperior port of this ciſtern are incruſted over with this fine ſulphur. This being one of the greateſt and moſt valuable curioſities of the town, the cover of the ſource is cloſely layed on, cemented, barred, and ſecured by ſeveral locks; the keys of which are kept by the Burgomaſters, who never permit it to be opened for any perſon, under the rank of a ſoveregne prince, or the repreſentative of ſuch; unleſs by ſpecial favor, for the information of ſome one, who is found to take uncommon pains in analyſing the baths. This moſt extraordinary favor was accorded to me, by the indulgence of the Magiſtrates and Citizens, who ſpared no pains in giving me every uſeful information, that related to the natural and civil hiſtory of their famous baths and city.

§ 144. In this ſource, the water ſprings up in ſuch plenty, as to furniſh ſeveral baths; as firſt, thoſe of Keiſer's badt, Caeſar's or the Emperor's bath, from being the place, where Charles the great eſtabliſhed his court and his bath, where he and all his train promiſcuouſly bathed; for, he is ſayd to have often received his leveè in his bath. But, theſe are now divided into ſeveral ſmaller baths of different kinds. Secondly, thoſe of the Little bath adjoining, which are furniſhed partly from the great ſource, and partly from another of inferior note, to the northweſt of the firſt. Thirdly, thoſe of the New bath, fivety or ſix-

ty

ty paces to the northeaſt of the emperor's bath; an handſome, modern building, with ſeveral moſt commodious and elegant baths, which derive all their water from the great ſource.

§ 145. From the depth of water, which always covers the immediate ſpring, and the number of aqueducts, it ſupplies, it is not eaſy to determine, with certainty, the manner of its ſpringing, nor the quantity it diſcharges; all that can be diſcovered, with reſpect to its ſpringing is, that it conſtantly throws off, as it riſes, a conſiderable quantity of air with a ſparkling and bubbling noiſe. And, from the number of baths, in each houſe, and the ſizes of them, which are very conſiderable, from four to five feet deep, and from eight by ten or twelve, to twelve or fourteen by ſixteen or eighteen feet ſquare, as well as from a large ſtream of waſte water, which runs conſtantly from the baths or the redundance of the ſource, the quantity may be judged to be very great.

§ 146. The water riſes in the ſource with continual ſparklings, or exploſions of ſmall air-bubbles, and ſometimes, by unequal intervals of large bubbles, which, with ſome noiſe, diſcharge their ſubtil contents at the ſurface of the water.

§ 147. 2. The next ſource in order, is that of the great ſtreet, in which the fountane of Thermal water ſtands, at which the waters are commonly drank. The opening of this ſource is between the fountane and St. Cornelius's bath. This ſprings up inferior in force and quantity to the firſt; but, ſufficient to ſerve the fountane, the ſeveral baths of the two magnificent edifices, called De Heeren Badt, that is, the Nobles baths, from the magnificence and elegance of their buildings, baths and other accommodations, and in part, that commodious good houſe, with its baths, called, from its firſt occupier, and ſince from its ſign, the Roſe-bath; which is alſo in part furniſhed by ſmaller ſources, one proper to itſelf, the other common between this and St. Cornelius's bath. But the

ſource

ſource of the fountane commands all the reſt: For, upon this being pumped dry, all the others want water. Each of theſe has a waſte water canal, which carries off the redundant water, when the baths are full and require none additional ſupply. A branch of this is carried with a ſmall fall under the floor of a little room, where there is a perforation to admit the vapor for the vapor bath; the other branch runs through a little ſquare well, which is known by the name of the Source or well, and kept open to the public in every houſe.

§ 148. The overflowings of theſe ſources, after they have ſupplied their ſeveral baths, together with ſome more obſcure ſprings, ſupply a large bath, made under a convenient edifice, for the uſe of the poor.

§ 149. The third ſource lies to the ſouth weſt of the great one, and ſupplies the baths of the houſe, called St. Quirinus's bath, entirely, and thoſe of the houſe, called the Little bath, partly. The redundance and waſte water of which runs into the ſame ſewer, that carries off thoſe of the great ſource.

§ 150. Before I procede to the examination of the waters, it may not be diſſatisfactory to explane the manner, in which theſe ſeveral ſources are conducted for the uſe and accommodation of patients.

§ 151. The ſeveral great and conſiderable ſprings are collected and confined in ſtanch and cloſe vaulted repoſitories, compoſed of ſtone and brick well cemented; and the water, by convenient ſtone, wood, or leaden aqueducts, is conveyed to the ſeveral houſes, which are, 1. the emperor's bath, 2. the little bath, 3. St. Quirinus's bath, and 4. the new bath, within the old city; and 5. Carol's or Charles's bath, from the ſign of the emperor Charles VI. and 6. St. Cornelius's bath, alſo from the ſign, the two grand houſes, adjoining each other, called De Heeren Badt; 7. the Roſe-bath, and 8. the Comphaus badt, or Poor-bath, in the new or outward city or ſuburbs; all known by ſigns or inſcriptions, which give them their reſpective names.

§ 152. In the first six houses, the water is disposed, so as to fill any of their baths, upon drawing out a plug, to a certain highth; at the mark of which, there is a sewer, by which, not onely the redundance, but all foulness, that floats upon the water; such as the light, terrene pellicle, or what commonly comes from the skins of men and other animals in baths does; is constantly carried off. In these, there are baths of all kinds, of all sizes; such as, 1. humid baths, for ordinary bathing; to hold from one to four, eight, ten, twenty or thirty persons, in any situation or posture desired. 2. Pumps, by which the whole, or any part of the body may be layed under the fall of one or more columns of bath water. 3. Vapor baths; so constructed, that the whole body, or any particular limb or part, may be incloſed in, or exposed to the action of, the compound vapor of the bath water. To most of which, are annexed dressing-rooms, as all are furnished with beds to lye in, to sweat or cool after any of the baths, as well as for ordinary lodging.

§ 153. Every bath, in these houses, is incloſed in an elegant room, mostly with a vaulted or coved cieling, and a louvre or opening at top, to give a current to the air, and a vent to the vapor of the water, and all well lighted. There is an area of a convenient breadth, with an hand-rail or balustrade, round each bath, or two or more sides of it; where the attendants can walk and wait with convenient safety, ready to help or to be sent for any thing, that may be found necessary. There are baths ready at all hours of the day or night. And any person may bespeak a bath of any kind or size he will, and of any degree of heat required; which may be had at a very short warning. Any body, that chooses it, may bathe quite alone; or upon ringing a bell, with which every bath is furnished, may have any attendance requisite. Some, in critical cases, are attended by their physician in the bath; who observes all the changes, the bath works upon the patient, and directs the heating or cooling the bath,

bath, or protracts or abridges the time of bathing, as the case and circumstances of the sick may demand. There is no promiscuous bathing of the sexes permitted: The husband and wife, unless well known to be such, are not admitted to bath together. And yet, every person, who bathes, is furnished with a small, thin linen apron, which goes between the thighes, and is suspended before and behind by a piece of tape tied about the waiste. This barely serves to cover the noble parts, which are forbidden to be exposed to vulgar eyes; but, does not hinder the effects of the bath, as the close canvas habits, injudiciously used in some places, must necessarily do.

§ 154. The eighth, called Comphaus badt, Compushauss, or rather Comphurys badt or the Poor-Bath, consists of one large bath, constructed like the rest, with stone; is large enough to contain at once upwards of twenty persons, and is inclosed in a large and lofty, but rude building.

§ 155. Every bath has a sewer at the high water mark, by which superabundant water, let in to heat or cool, the bath runs off and carries with it any filth or foulness, that floats upon the bath. The bottom and all the inside of each bath, except a few of the single or smallest baths, are made of hewen stone. Each has an opening furnished with a plug at bottom; by the drawing of which, the bath may instantly be made as shallow as desired; and by stopping this, and opening the conduits of hot or cold water, it can as readily be raised to the depth of about five feet, or upwards, if required; by stopping the sewer before mentioned.

§ 156. By the opening in the bottom, the baths, as often as they are fouled, are emptied. After which, the whole repository or bath is scrubbed all over with a birchen beesom and washed with clean water, while it can fully it. Then, it is filled by opening the plug of the conduit in a few hours at the most; more or less, according to the size of the bath.

But, unleſs cold water be admitted, as may be in ſome baths, particularly in the New bath; where, they have a reſervoir for cold bath water for this purpoſe; the bath, as I am informed, rquires from ten or twelve, to ſixeen or eighteen hours to cool to a fit temperature for bathing; according to the different heat of the ſource from whence it ſprings and the cold or heat of the ſeaſon. In which time, much, if not all, of it's volatile parts are diſſipated; ſo that none but the ſaline and ſome of the terrene parts, remane ſuſpended in the water.

II. *Of the Nature and Quality of the* THERMAL WATERS *of* AKEN; *firſt, from ſenſible appearances, and ſecondly, from analytical experiments and obſervations.*

§ 157. Having taken a view of the ſeveral ſources, let us now deſcend to particulars, to the examination of their reſpective contents. As the Magiſtrates were ſo indulgent, as to lay all the ſources of theſe much famed waters open to me, and I examined them all on the ſpot; I ſhall here fairly relate the ſeveral experiments, I made upon them, and the obſervations, that occurred upon the occaſion. I ſhall begin my relation where mine experiments began, at the emperor's bath; and ſhew, as I go along, in what material points each of the others agrees with, or differs from, this.

§ 158. I do not believe with the fabulous hiſtorians of Aken, that the waters were diſcovered by accidentally feeling them hot, by man or beaſt paſſing that way; for, I am ſure, the firſt ſenſe they affected, muſt have been, as now, that of ſmelling: ſince, it is impoſſible for a ſtranger to come near them and not be ſurpriſed at the ſmell of the vapor. An horſe ſmelling them, would, in mine apprehenſion, be alarmed and diſcover ſome uneaſineſs to his rider; and I ſhould think, no man could be ſtruck with the ſmell of theſe waters, in the rudeſt and moſt ignorant

rant age of the world, without a curioſity to enquire and ſearch out whence it came.

§ 159. The Inhabitants of Aken, or even thoſe, who reſide ſome time in the city, are not more ſenſible of the ſmell of theſe waters, than the inhabitants of great cities, in which foſſil coal is burned, of the ſmell of their ſmoak. But, ſtrangers or any perſons newly coming out of the freſh air, upon approaching either, are readily ſtruck with the remarkable odor. This vapor, however, is ſo ſubtil and volatile, that it is immediately diſſipated in air, as ſoon as it eſcapes from the water, and ſo is ſeldom perceptible, at any diſtance from the bath; except in cloſe, cold, foggy weather.

§ 160. But, upon going towards the fountane, any of the ſources or aqueducts, or any of the baths, eſpecially newly filled, it ſtrikes the organs of ſmell with a moſt ungrateful odor, which may be truly called ſulphureous; as will appear when we come to ſhew, it carries with it, if not actual particles, the eſſential or component parts, of that mineral.

§ 161. This ſmell may be compared, 1. to that, which ariſes upon pouring the acid of vitriol upon filing of iron; in the action of diſſolution of which, actual ſulphur is produced in the liquor, as well as in the vapor, from the union of the abundant inflammable principle of that metal, with the univerſal acid; 2. to that of a ſolution of ſulphur * in an alcaline ley; or rather, 3. to that, which ariſes upon dropping a mineral or vegetable acid into a ſolution of ſulphur in an alcaline ley; in which ſulphur is revived or regenerated; 4. to that which the waſhings of a gun, fouled by the frequent firing of gun powder afford; for, this is a kind of ſolution of ſulphur in nitre alcaliſed by burning with ſulphur and charcoal, the ingredients of that violent combuſtible; or, 5. to that, which ariſes upon throwing water upon burning coals,

* Idea of Salts, § 52. 85.

in which, ſome particles of the burning ſulphur or phlogiſton is blended in the vapor, and ſtrikes the ſenſes, as every other like mixture, which contains ſulphur muſt do. Such is the ſmell, with which the vapor of all the waters of Aken ſtrike the ſenſes; thoſe eſpecially, whoſe ſources are cloſe covered and are not long drawn: For,

§ 162. Upon ſtanding to cool, this odor vaniſhes; yet, not ſo as to be totally loſſed upon cooling: For, unleſs it has ſtood expoſed to the open air a long time, the ſmell may be once, in ſome meaſure, recovered upon heating; but, then, it is irrecoverably loſſed. Thus, the water, which while hot and newly taken from the ſource, has a ſtrong, ſulphureous, offenſive ſmell; When cold, is almoſt quite inodorous. But, upon being again ſet in greater motion by heating, what remaned of the volatile parts undiſſipated before, now begin again to fly off and continue, till all have eſcaped and left the water quite inodorous, perfectly freed from it's volatile, ſulphureous parts. Time alſo produces the ſame effect, in ſpight to all known means for preventing it.

§ 163. This volatile, odorous matter, to which we ſhall ſpeak more particularly in it's place, abounds moſt in thoſe waters, which are derived from the great ſource, as the Emperor's, the New and the Little baths; from every one of whoſe vapors, more or leſs pure ſulphur is collected, in all the aqueducts of their baths. Next to theſe, the other waters are impregnated with this volatile and odorous vapor in the order, in which I here ſet them down, 1. The Fountane, which is kept conſtantly ſupplied with water, by continual pumping for three or four hours every morning during the ſeaſon. 2. St. Cornelius's, and 3. Charles's baths, whoſe ſources were never known, nor imagined, to yield ſulphur, till I diſcovered it, in the year 1752. 4. The Roſe bath. And 5. and laſtly, St. Quirinus's bath. Though I am apprehenſive, that had the waters of theſe two laſt baths, like the others,

others, been kept in close covered or vaulted reservoirs or cisterns, and been more frequently discharged or set in motion, as the others are; they might be found more strongly impregnated, than they now appear, and might give other proofs of their containing the same principles of sulphur, that the others do, in a smaller proportion.

§ 164. Before, we procede further, it may be satisfactory here to point out the uses of those experiments and observations. They teach us then, 1. that these waters contain something very volatile and active; which is, in a great measure, lossed in lying exposed to the open air to cool, and which is entirely dissipated upon reheating. 2. That the waters are much altered upon losing it; as will further appear upon succeding experiments. 3. That their practice is ill founded, who sendthis water from Aken in wooden or any other vessels, to be again heated for baths. 4. That such baths must want the principal active ingredient, which will appear to contain the principles of sulphur, and 5. That, if the sulphur in these and such like waters be thus volatile, as I apprehend it will always be found, they are but absurd Physicians, as well as most ignorant Naturalists and Chemists, who look for sulphur in the residuum of waters after evaporation.

§ 165. In aspect, no water more colorless, clear, pelucid, and bright, than that of the Emperor's bath and the others deriving their waters immediately from the great source. A very minute object may be seen at the bottom of the deepest bath, newly filled. So bright is the water, that if the bath, just filled with it, be viewed at rest, and in such a direction, as does not reflect the light from the surface to the eye, it will at first sight, be thought empty. Viewed also in a glass, it appears quite colorless and bright at first; but, upon a closer examination, after some standing especially, it is found full of very, minute, light attoms aflote in it. Upon standing open to cool, it loses it's

brightneſs and limpidity; acquires a milky, turbid appearance; loſes, in a great meaſure, it's ſmell; lets fall a light, pale, terrene ſediment; while a pellicule riſes to the ſurface of an aſh-coloured, ſoft, unctuous-feeling ſubſtance, which is diligently ſcummed off the baths as it riſes, to prevent it's falling to the bottom or adhering to the ſides of the baths and fouling them. This has long been looked upon as a kind of bituminous ſubſtance; but, I ſhall ſhew it to be none other, than a pure calcarious earth, moſt ſubtilly divided and ſuſpended in the water, while it retained it's volatile principles; but upon their diſſipating, ſeparated. See § 61. 335. The ſmell, as well as pelucidity, of the water, thus loſſed, may in ſome meaſure for once be reſtored by heating; but, after that, both are for ever loſſed; till the water depoſites it's terrene parts, by which its pellucidity alone is, in ſome degree, recovered.

§ 166. This ſhews, that the water in it's ſource contains ſomething extremely volatile, which is the proper ſolvent of it's terrene parts; and which being evaporated, ſuffers theſe terrene parts again to coaleſce, and by their own gravity to preponderate and ſubſide. Hence, we ſee, that the waters newly drawn, and thoſe ſometime expoſed to the open air are very different in their nature: For, they not onely loſe their heat and moſtly their ſmell, upon ſtanding and cooling; but they are thereby deprived of the ſolvent of the terrene parts; which are therefore now no longer united with the water; but in a great meaſure, ſeparated and precipitated. For theſe reaſons, it is, that the waters of the baths of St. Quirinus, St. Cornelius, Carolus, the Roſe, and that of the Fountane are ſeldom found as pellucid, or as ſtrong-ſmelling as thoſe, whoſe waters are often drawn and whoſe ſources are kept cloſer covered. The fountane, which runs for ſome hours every day, and St. Cornelius's bath, which is much frequented, continue clear, when the waters of the neighbouring baths are milky and turbid. This Milkineſs is by ſome falſely attributed

to

to thunder, when that happens; but, it's not being at any time univerſal, ſhews the former, not the later, the juſt method of accounting for this loſs of it's natural limpidity. Though the ſediment, which theſe waters, at firſt ſtanding, depoſite, be of a pale aſh-color; yet, with time, it grows black in the baths, reſervoirs, aqueducts and canals, which are, if ſuffered, filled up with a light mud, as black as wet Aethiop's mineral. To this, the ſulphur, generated in the vapor, contributes not a little: For, this by any accident falling to the bottom, ſoon grows black, and augments the color and volume of the ſediment, inſtead of ſubliming, as ſome ſuperficial obſervers have imagined and taught. This ſhews the miſtakes of thoſe, who imagine the ſediment of theſe waters ochrous or martial; as the ingenious BERGER [a] has done, and after him, the great HOFFMAN [b].

§ 167. It is not very eaſy to give a juſt idea of the taſte of this water. Some compare it to that of rotten eggs, with what propriety, let thoſe judge, whoſe curioſity has led them to taſte ſuch putrid bodies. To my palate, it appears ſaline, ſomewhat bitter and lixivial or urinous; which, with it's ſmell, makes it nauſeous, and to delicate ſtomachs, eſpecially at firſt taking, ſo offenſive, as to make them reach and vomit. But, by cuſtom, it becomes familiar and even agreeable to moſt. The hotter it is, the quicker the ſmell; the ſtronger, the more bitter the taſte; each of which qualities declines in proportion, as it cools. Hence, the waters at the fountane and of the other ſuburbian baths, as well as thoſe of St. Quirinus, are leſs odo-

[a] Comm. de Thermis Carolinis, p. 69. *Ochram vero thermas vehere* (inter alias) Bathonienſes *in Anglia*, Barbonienſes *in Galliis*, Aquenſes, *&c. in Germania*, &c. &c.

[b] De Convenientia element. ac virium in thermis ac acidulis.— *Nullum enim fontem medicatum vidimus, nullas thermas, vel acidulas, quae non circa ora fontana, ochream, magis vel minus flaveſcentem maſſam depoſuerint, quae bene elota & calcinata non exhibuerit pulverem, cujus ramenta magneti prompta acceſſerint. Horum claſſem imprimis ducunt ex thermis* Carolinae, AQUISGRANENSES, &c.

rous

rous and ſapid, and conſequently, leſs diſagreeable to the noſe or palate, than thoſe of the more cloſe and more frequented ſources. It is probably owing to no better a cauſe, that theſe waters have always been preferred for drinking, Though, it be certain, that the firſt, when, by ſtanding open, deprived of their more volatile parts, will be found in general equal, if not, in particular caſes, ſuperior, to the others.

§ 168. To the touch, the cooleſt of theſe waters, near its ſource, is intolerable. But, few of them are found ſo in any of their ordinary conduits; except thoſe immediately deriving from the great ſource.

§ 169. I examined, among other circumſtances, the heat of the ſurface of the water in the great ſource in the preſence of the magiſtrates; and found it, compared to the atmoſphere, by Farrhenheit's thermometer, as 128 to 88. By De Liſle's, as $51\frac{1}{2}$ to 8. But, I found it ſtill hotter in the conduits and in the ſources or wells of the baths; which will not be wondered at, when it is conſidered, they run immediately from the ſpring, not from the top of the reſervoir, where the water has time to cool.

§ 170. While the mercury in this thermometer roſe no higher in the ſurface of the great ſource, than 128. It roſe,

1. In the ſource or well of the Emperor's bath, to - - - - - - 136.
2. In the ſource or well of the New bath, to - - - - - - 134.
3. In the ſource or well common between the Little and St. Quirinus's baths, to - 120.

§ 171. The degrees of heat in the vapors of theſe waters, as they are conveyed from an opening in the aqueduct under the vapor bath, ſtands thus,

1. In the vapor of the Emperor's bath, the mercury riſes to - - - 128.
2. In the vapor of the New bath, to - 120.
3. In the vapor of the Little bath, to - 116.

Which is found ſcarcely hot enough, and none of the others

others afford ſo hot a vapor, under the preſent oeconomy; wherefore vapor-baths are no where elſe, within the city, attempted.

§ 172. Having with me a ſmall and more portable thermometer made by Watkins, whoſe ſcale was not graduated above 120, I found, theſe three ſources raiſed the mercury, not onely above any degree on the ſcale, but even to the utmoſt extent of the tube. But, for all waters, whoſe heat could not raiſe the mercury above the degree marked on the ſcale, I found it exact and juſt enough; with this, then, from the greater convenience and ſafety of carrying it, I contented myſelf with examining the other ſources. In this, the mercury was raiſed,

1. By the ſource or well of St. Quirinus's bath, to - - - - - } 120.
2. By that of St. Cornelius's bath, to 116.
3. By that of the Roſe-baths, to - - 115.
4. By that of Carolus's bath, to - - 113½.
5. By the fountane, where they commonly drink, to - , - - } 112.

§ 172. The weight of the ſeveral waters hot, as they run in their ſeveral ſources, and cooled to the ſame degree in the ſame air and veſſels of the ſame ſize and make, gives ſome idea of the different heat and the different degrees of impregnation with ſolid contents.

§ 173. A flint phial, with a ground ſtopple, as before deſcribed, weighing two ounces, five drachms, two ſcruples and nine granes, containing two ounces three drachms and one grane cold deſtilled water; filled with the ſeveral waters following, weighed as follows, by a Dutch balance and weights;

	ounc.	dr.	ſcr.	gr.
1. Deſtilled water heated to 136 degrees - - -	5.	0.	1.	16.
2. The ſame cold to 88 -	5.	0.	2.	10.

3. The

	ounc.	dr.	ſrup.	gr.
3. The ſource of the Emperor's bath, of it's proper heat, in the ſame phial, weighed	5.	0.	1.	19.
4. The ſource of the New bath,	5.	0.	1.	19.
5. The ſource of the Little bath,	5.	0.	2.	2.
6. The ſource of St. Quirinus's bath,	5.	0.	2.	4.
7. The ſource of Roſe-bath,	5.	0.	2.	8.
8. The ſource of St. Cornelius's bath,	5.	0.	2.	2.
9. The ſource of Carol's or Charles's bath,	5.	0.	2.	3.
10. The Fountane	5.	0.	2.	9.

§ 174. This table comes in aid of the thermometer, to ſhew the different degrees of heat of the waters; the moſt heated, being the moſt rarefied, conſequently the lighteſt, volume for volume conſidered: If they were of the ſame heat, it might ſhew the difference of gravity between each, which ariſes from the different proportions of ſolid parts, with which they are impregnated.

§ 175. From theſe experiments, together with thoſe with the thermometer, we ſee, that the waters are hot in the following order; the hoteſt is 1. That of the Emperor's bath. 2. That of the New bath. 3. That of the Little bath. 4. That of St. Cornelius's bath. 5. That of Carol's bath. 6. That of St. Quirinus's bath. 7. That of the Roſe-bath. And, 8. and laſtly, that of the Fountane. Thoſe that appear moſt light are the hoteſt, as well as the moſt ſtrongly impregnated with volatile parts: The 1. and 2. are alike in weight, and each three grains heavier, than the like meaſure of deſtilled water of the ſame heat.

§ 176. However, there is nothing to be determined with ſufficient accuracy, by weighing of waters, that are not always to be found of the ſame temperature. The heat of theſe waters varies, perhaps, as often,

as

as that of the atmoſphere; but, from a different cauſe; for, that hardly affects them in the cloſe ſources; eſpecially, when frequently drawn or pumped. The temperature of all, but the three firſt, depends greatly upon theſe circumſtances. I have at different times compared them; and, though I have with certainty determined the greateſt heat, in which they have been found, in my time, and marked it; yet, it would be endleſs to point out the variations, that ariſe from the cauſes before mentioned, to wit, the frequency of drawing or pumping the baths. However, for the ſatisfaction of the reader, I ſet down trials, made at another time upon the waters hot, that is, of the natural heat, and cold, that is, the ſame waters cooled to the ſame degree, in phials, of the ſame dimenſions, in the like time and ſituation.

§ 177. A table of the different weights of the thermal waters of Aken, hot and cold, taken in a glaſs phial with a ground ſtopple, weight two ounces, five drachms, two ſcruples and five granes; and, filled with cold deſtilled water, weighing five ounces, two ſcruples and three granes, in the moſt exact apothecary-ſcales, and with the beſt weights, the town afforded. This full of,

1. The ſource or well of the Emperor's bath, hot, weighed	} ounc.	5.	0.	1.	17.
The ſame cold,	——	5.	0.	2.	8.
2. That of the New bath, hot,	——	5.	0.	1.	17.
The ſame cold,	——	5.	0.	2.	8.
3. That of the Little bath, hot,	——	5.	0.	1.	18.
The ſame cold,	——	5.	0.	2.	8.
4. That of St. Quirinus's bath, hot	——	5.	0.	1.	19.
The ſame cold,	——	5.	0.	2.	6.
5. That of St. Cornel. bath, hot,	——	5.	0.	1.	19.
The ſame cold,	——	5.	0.	2.	6.
6. That of Carol's bath, hot,	——	5.	0.	2.	0.
The ſame cold,	——	5.	0.	2.	5½.
7. That of Roſe-bath, hot,	——	5.	0.	2.	1.
The ſame cold,	——	5.	0.	2.	6.
8. That of the fountane, hot,	——	5.	0.	2.	2.
The ſame cold,	——	5.	0.	2.	7.

This

This ſhews ſome variations, from the cauſes before aſſigned; but, the proportions will be found to agree as far as experiments of this nature will readily admit: They help our conjectures and direct us to further trials, to which we procede.

§ 178. The common uſes, to which the waters are put, often afford ſome uſeful hints towards an inveſtigation of their properties or contents, if not ſome certain indications of both. The firſt mechanic uſe of theſe waters, that occurs to a diligent enquirer, is that of waſhing and ſcouring wool, woollen and linen cloaths, &c. in them. This is ſo well known, that the magiſtrates have left ſeveral parts of the ſewers, that carry off the waſte waters of the ſources and baths, open, and made proper conveniencies for fullers, landreſſes, &c. to waſh and ſcour their cloaths, &c. therein. The heat of the waters alone would not be ſufficient to encourage this practice, had the waters been hard; but, they are found ſoft, even lixivial; eſpecially when the volatile parts are diſſipated, as they are pretty much at the diſtances from the ſeveral ſources, at which they are thus uſed. And thus, the artiſans, that uſe warm leys, and the poor landreſſes are by the means of theſe thermal waters, ſupplied, without the expence of firing or ſope. Upon this ſole obſervation, every rational phyſical mind muſt pronounce theſe waters ſoft, if not lixivial, and void of iron; ſince, that would diſcolor the linen, as BERGER[a] obſerved the Caroline baths to do. This is another proof of his having miſtaken theſe waters, in giving them the ſame ſediment, as well as qualities, with the Caroline and our Bath waters and others.

§ 179. An other obſervation, taken from the vulgar uſes of theſe waters, will further countenance this opinion. The people of Aken boil their coleworts, lettuces, aſparagus, common and kidney beans, peas, &c. in the bath waters; finding by experience, that the boiling of theſe vegetables is facilitated and

[a] Book cited.

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expedited, and that they acquire a peculiar grateful flavor and tenderneſs, and have their color preſerved or improved, by means of the ſalts in theſe waters. The reverſe of which would be the caſe, theſe would be more ſlowly boiled, hardened and diſcolored, had the waters been hard or impregnated with metals or earths; and inſtead of an agreeable, they muſt acquire a nauſeous taſte, had not the ſulphureous parts been ſo volatile, as to fly off entirely, before the waters acquire a boiling heat.—Would they not improve fermented bread?

§ 180. From theſe ſimple experiments and obſervations, we muſt be convinced, that this water contains, 1. ſomething very volatile, and of the phlogiſtic or inflammable kind, by its ſmell; 2. an earth, which precipitates, when theſe volatile parts are exhaled, adhering in form of a ſtone to the ſides, or falling to the bottom of the baths; 3. Certain ſalts, the proportion and nature of which are to be determined by further and more accurate experiments.

III. *Of the Volatile and Phlogiſtic Parts in the Waters of* AKEN.

§ 181. Every man, who has the ſenſe of ſmelling, will readily be convinced of the exiſtence of theſe volatile and phlogiſtic principles in theſe waters, upon approaching any of the ſources or baths, or the fountane: While the waters are warm, theſe are continually exhaling, till they are totally diſſipated. And in proportion, as theſe fly off, the terrene ſubſtance partly flotes on the ſurface, partly ſubſides, or adheres to the ſides of the repoſitories, and aſſumes in time an hard, conſiſtent form, or falls, like a magiſtery, to the bottom; the ſalts onely remaning ſuſpended in the water, till it be evaporated; when they are obtained in a concrete form.

§ 182. The firſt or volatile and phlogiſtic parts are they, that characteriſe theſe curious and invaluable waters.

ters. They firſt and beſt deſerve our attention. And therefore, we firſt procede to illuſtrate them.

§ 183. The firſt thing, that occurred to me in conſidering theſe volatile parts, which ſo remarkably affect the organs of ſmell, and conſtitute the moſt valuable ingredients in the compoſition of theſe waters; was to enquire what ſenſible effects they produced. I obſerved, 1. all the iron work about the baths greatly corroded; and that ſuch pieces of iron, as lay near any crack in the aqueduct or any ſmall perforation, by which the vapor of the waters iſſued, was corroded into a vitriolic ſubſtance, of a ſweetiſh, auſtere taſte, partly ſoluble in water, and blackening with galls and other aſtringent drugs. I obſerved, 2. That lead endured in the open air of the town, as long as any where elſe. But, the pumps and pipes in the baths were all corroded into a ſoft, friable, flaky, blackiſh ſubſtance. I found, 3. that linen and paper were reduced, in appearance, to a rottenneſs, upon being held or confined in the vapor; and 4. that wooll or woollen ſtuffs or cloaths and ſilks were whitened by the ſame means. I found, 5. that in whatſoever brick vault this vapor was long confined, the vault became firſt incruſted over with a kind of a white ſtalactite; a kind of ſtoney concrete, ariſing from an abſorbent earth and a mineral acid, like a ſort of froſting, and afterwards, that ſulphur was collected in conſiderable quantities on this firſt layer; unleſs the more ſubtil, phlogiſtic part of the vapor eſcaped by the admiſſion of air by ſome caſm or perforation. 6. I obſerved a ſaline efflorescence upon ſome ſoft, fiſſil, aſh-colored ſtones, in ſeveral parts of the buildings; particularly, near the ſource of Carol's bath. This ſtone, I took to be wood petrified. Of this, I was the further convinced, upon finding the ſaline efflorescence, and the ſtone itſelf, by elixiviation, gave a kind of alum: It was auſtere and ſtyptic to taſte; curdled milk; was coagulated and precipitated by alcalies.

§ 184.

§ 184. From theſe obſervations, I naturally concluded, that theſe waters contained the acid and the phlogiſton, by either of which, theſe and many ſuch like effects were produced, and by the union of both of which, ſulphur was generated, in the vaults of the Great Source and its aqueducts; not ſublimed, according to the vulgar and univerſally received opinion. And now, to give more convincing proofs of this acid and this inflammable principle, 1. ſeparately, and, 2. jointly in the concrete, ſulphur, which is compoſed of the union of both; let us procede to ſome further experiments and obſervations.

IV. *Of the Acid Spirit of the Waters of* AKEN.

§ 185. 1. If linen rags be dipped in ley of tartar, or of any alcaline ſalt, and then dried at the fire, they will contain much of the ſalt. If then theſe rags be ſuſpended in the vapor of the Emperor's bath water, they will, in a few hours, be ſaturated; ſo as to change their alcaline, lixivial taſte, to that of a bitter, neuter ſalt. And then, upon elixiviation, they will yield an alcaline ſalt ſaturated with the vitriolic acid; to wit, tartar vitriolate. This is an inconteſtable proof of an acid; the nature of which will appear,

§ 186. 2. By pouring upon this neuter ſalt, in a glaſs retort, or a matrace, with a fit head and a recipient, the concentrated acid of vitriol, and then deſtilling it by a proper heat, in a ſand furnace: It affords the ſubtil acid of vitriol or ſulphur, volatiſed by ſome portion of the inherent phlogiſton, as it is explaned by one of our greateſt modern Chemiſts[a] and Phyſicians.

§ 187. 3. Theſe, with the preceding obſervations, put the exiſtence and nature of the acid of Aken waters out of all diſpute: Though it was looked upon as a moſt ſtrange and dangerous innovation, a kind of phyſical hereſy, tending to ſubvert the phyſical craft,

[a] STAHL. Fund. Chem.

by the greateſt number of the practicioners about that city and republic.

§ 188. 4. This acid was eaſily detected and demonſtrated. But, we now come to a more ſubtil ſubject, the inflammable principle, moſt apt to eſcape our too groſs ſenſes; to which, from it's moſt extreme and inconceivable tenuity of parts, as a principle, or firſt elementary body, it muſt remane incogniſable, except from it's ſmell and the other effects, it produces.

V. *Of the inflammable Principle in the* AKEN WATERS.

§ 189. 1. This then is firſt manifeſt to the ſenſe of ſmelling: Every one muſt confeſs, that ſomething, which ſtrongly ſtrikes the organs of this ſenſe, is blended with, and continually flies off from, the water, inviſibly in it's exhalations or vapor.

§ 190. 2. This is diſcovered by the various effects, it has on certain metallic bodies, either entire or in a ſtate of diviſion or ſolution. 1. It is more than probable, that it is from this ſubtil principle blended with the acid, that the leaden pipes and utenſils about the baths and ſources are penetrated and reduced to a ſtate, not unlike that of lead ore or lead fuſed with ſulphur: For, this is the caſe, and this the acid alone could not eaſily effect. 2. A piece of poliſhed braſs ſet ſtanding in a glaſs of the Emperor's bath water newly drawn, the part under water ſhews no change in four hours, while what lyes above the ſurface of the water gets firſt a pale, then a deep gold color, and ſoon after becomes variegated with all the ſhades of red, orange and purple. In about twelve hours, ſome ſhades of theſe tarniſhed tinges got to that part of the braſs, that lay below the ſurface of the water, beginning with a pale yellow, and ending in the variegations mentioned; all which diminiſh towards the bottom, or are higheſt near the ſurface. The braſs being dried, tarniſhes ſtill deeper, with a muddy green hue. 3. A piece of clean poliſhed ſilver, put into a glaſs of the ſame water in like manner;

ner; the part immerged in the water is, in a few ſeconds, tinged of a gold color; and ſoon after, becomes tarniſhed with different ſhades of red, orange, purple and black. The part above the water is but ſlightly affected; nor is it much more, in the vapor of evaporating water. But, in the vapor of the ſource, it is almoſt inſtantly, ſenſibly affected. It acquires a pale gold color in leſs than a minute, and in three, is carried to the higheſt degree of tarniſh. 4. In this manner, the color of gold is highthened, and ſilver is changed to the color of gold firſt, and then tarniſhed. Gold trimmings to cloaths do not ſuffer at Aken; but thoſe of ſilver are ſoon deſtroyed. 5. The waters and vapors of the Fountane and other adjacent ſources produce ſimilar effects, but more ſlowly, than thoſe drawn from the Great Source. 6. None of the waters cold produce theſe effects readily, nor in ſo high a degree, though kept cloſe ſtopped. And none of them will produce theſe effects, after lying long expoſed to the air, or after being ſpoiled of their volatile parts and offenſive ſmell by boiling.

§ 191. Theſe extraordinary effects then, are produced by the volatile parts of theſe waters. Experience convinces us, that this can not be done by the acid alone. It muſt then be from the phlogiſton or inflammable principle. The onely means, by which art is capable of impregnating water with ſulphur, is by diſſolving that mineral in an alcaline ley or volatile alcaline ſpirit. Such a liquor and it's vapor, has nearly the ſame properties of tinging braſs and ſilver with theſe waters; but, in theſe, there is not ſo fixed and permanent an union of the acid and inflammable principle, till both fly off together, and uniting form the ſulphur, which till now has been looked upon as flowers of ſulphur, the product of ſublimation; which I ſhall demonſtrate to be abſurd, as it is impoſſible.

VI. *Of the Sulphur of* AKEN WATERS.

§ 192. 1. The ſtrongeſt proof of the exiſtence of a volatile mineral acid, and of the phlogiſton in theſe waters,

ters, is the production or generation of ſulphur, found in the vaults of the cloſe covered ſources and aqueducts. Sulphur is proved by the chemiſts to conſiſt of the univerſal acid and the phlogiſton or inflammable principle. Theſe, in the proportion of about fiveteen parts of the former, to one of the later, reduced to a ſubtil ſtate of diviſion and brought into contact, coaleſce and form the concrete, ſulphur. See the General Idea of Salts, § 52. Trial and choice of Simple waters, § 196. Natural productions of Aken, § 79 to 87.

§ 193. 2. When ſulphur is thus once produced by nature or art, it is no longer ſoluble, or intimately miſcible with water, nor even with burning ſpirits, without the interpoſition of an alcaline ſalt, fixed or volatile. In the concrete form, it is not fuſible, in the heat of boiling water: It requires a naked fire to fuſe it; and when it is fuſed, it becomes volatile: For, the degree of heat, capable of fuſing it, being continued, without ſetting it on fire, it will all fly off. If the ſubtil vapor be received and condenſed in proper veſſels, it will give what is called Flowers of Sulphur, and the proceſs is called Sublimation.

§ 194. 3. Whenever the vapor of the thermal waters of Aken are long confined, eſpecially in vaults compoſed of brick and mortar; there, a kind of ſtalactite firſt covers the ſurface of the wall, and this in time is followed hy another covering, which begins like an hoar froſt, with its ſurface like that, ſpangled with little bright, ſhining cryſtals. This gradually increaſes, till it comes to the thickneſs of an inch, two or more, if it be not interrupted in its growth. It's color is a paler yellow, than that of ordinary ſulphur or its flowers; ſtill preſerving it's ſhining ſpangles. It's conſiſtence is ſoft and pultaceous, not unlike that of the magiſtery or precipitate of ſulphur before drying, to the touch. But, when it dries, it's color becomes much paler, not very remote from that of ſulphur precipitate; whoſe conſiſtence, when dry, it alſo emulates. However, it greatly loſes the brilliancy of its

little

little froſt like cryſtals, and upon breaking, it appears, as if it were lamellated and ſtriated, like a petrification or a calculous concretion; ſo that the ſtrata, by which it increaſed, may be diſcovered; yet, it is ſtriated or radiated tranſverſly throughout, in the manner of fuſed ſulphur.

§ 195. 4. This collection of ſulphur has always been, and, though I demonſtrated the contrary to all the phyſicians of the town, before the magiſtrates, who deſired them to attend; ſtill is, looked upon to be the reſult of ſulphur ſubſtantially diſſolved and ſuſpended in the waters, and by their heat, ſublimed in the vaults of the ſources and aqueducts. But, I am induced to think, that there is no ſulphur actually or ſubſtantially diſſolved in the water; but, that the principles of that foſſil, to wit, the acid and the phlogiſton are blended with the waters; yet ſo, as not to come into ſuch a contact, as is neceſſary to occaſion the union requiſite for the production or generation of actual ſulphur; till both theſe volatile parts, flying off together, are confined in the vapor in the vaults, ſo as the union and conſequent generation is readily brought about; and that for the following, among other reaſons;

VII. *Of the Generation of Sulphur in the Waters of* AKEN.

§ 196. 1. A much ſmaller portion of actual ſulphur, than appears to be in theſe waters, by their ſmell and other effects mentioned, by any known means of art diſſolved in them, would give a ſenſible yellow color to a larger quantity of water. But, theſe thermal waters are abſolutely colorleſs, as the ſimpleſt water known. They may then, in mine apprehenſion, contain a great proportion of the principles of ſulphur, but not of actual ſulphur, without change of color. Here then, is no change of color; conſequently, theſe waters are not to be looked upon, as a ſolution of ſulphur, or to contain actual or ſubſtantial ſulphur,

§ 197. 2. If theſe waters were ſuch a ſolution of ſulphur, an alcali muſt be predominant in them, and acids would cauſe a preipitation. But, the volatile acid is evidently contained, though not actually predominant, in them; as appears by various experiments [a]. Then all the mineral acids, inſtead of cauſing any precipitation, as they muſt do in all ſolutions of ſulphur; increaſe and preſerve the pellucidity of theſe waters [b]. Conſequently, they are not ſubſtantially, though they be eſſentially, impregnated with ſulphur. Which contradicts a received canon, that waters ſmelling like putrid eggs, are ſulphureous, by which the aſſerters of it, if any thing, mean an actual ſolution of ſulphur.

§ 198. 3. But, beſides, theſe waters are not capable of fuſing, much leſs of diſſolving ſulphur, not even their own ſulphur, when fallen into, or even boiled in, them for many hours: When their native ſulphur falls into the ſource, it ſinks to the bottom, mixes with and increaſes the volume of the black mud, which they depoſite; whoſe color is derived from the ſulphur.

§ 199. 4. To demonſtrate the firſt and ſecond poſitions, let the following experiments be made;

§ 200. 1. Let half an ounce of pure flowers of ſulphur be put into a convenient glaſs veſſel. To this, let three or four pints of new drawn thermal water be poured, agitating them frequently together. They will in no ſort mix: for, the ſulphur will be found floting on the water. Let them then be poured together into a convenient glaſs matrace, with a proper head. Let it be placed in ſand, and adapting the head, with a fit recipient, and luting the junctures, let the fire be gradually raiſed, till the water boils, and be kept ſo, till two thirds of the water be deſtilled.

§ 201. The reſult of this operation will be, 1. a deſtilled water of an empyreumatic or aduſt and ſulphureous ſmell and taſte; but, in weight, as well as effects with various ſolutions, it will not eſſentially dif-

[a] § 183. to 188. [b] § 257. to § 269.

fer

fer from common water deſtilled; except, in growing milky with a ſolution of corroſive ſublimate, which the thermal water alone deſtilled will effect. 2. In the head, a very inconſiderable quantity of little, white flakes, reſembling the flowers of benjamin, will be found. 3. The reſt of the ſulphur, without any conſiderable loſs, will be found in the bottom of the remaning water in the matrace, ſpoiled a little of it's color. The remaning water will appear a little colored; but upon letting it ſtand to ſubſide, or upon filtrating it, this coloring matter, which is but a light earth, will be ſeparated from it. Ther, the water will not be found to differ from the remainder of the like quantity of the thermal water evaporated or deſtilled to the ſame pitch; except, that the former will not be quite ſo alcaline: For, it does not ſo ſuddenly turn green with ſirup of violets, as the later. But, if the deſtillation or coction be protracted, ſome portion of the ſulphur will be diſſolved in it, by means of it's alcaline ſalt.

§ 202. Now, were ſulphur capable of fuſion in boiling water, it would fuſe in this deſtillation. But, it does not. And, if it does not fuſe, how can it be ſuppoſed to ſublime, in an inferior heat? for, ſuch is that of the hotteſt of theſe ſources or baths.

§ 203. But, as the native thermal ſulphur is more ſubtil and light, than this artificial preparation; let the ſame experiment be made with that, and ſee the reſult. If the ſame proportion of the thermal ſulphur and water be deſtilled with the like care and caution, as in the preceding; the native, like precipitate of ſulphur, will be found to mix with the water, and then ſlowly ſubſide, leaving onely a thin, light pellicule on the ſurface. As ſoon as the water acquires the boiling heat, the ſulphur will gradually riſe and flote, like a thick ſcum upon the ſurface, of a color more yellow, than that of which it was put in, and ſo ſmooth, as to ſeem, at firſt ſight, melted. When it boils thoroughly, ſome portion of the ſulphur will ſeem to

riſe, as if ſublimed above the ſurface of the water. The like flakes, as in the ſame proceſs with the flowers of ſulphur, will riſe into the head, in far greater quantity, and the water, that firſt deſtils, will ſeem to be ſomewhat milkey, being loaded with theſe little, light flocculi. All, that can be collected of theſe little flowers, will hardly weigh ten grains, when dry. The water, that will deſtill, will be more inodorous and inſipid, than that deſtilled with the common flowers; will agree in weight and other qualities with it; but that of growing milky with a ſolution of mercury ſublimate, in which this will be found to excede that, ſomewhat. The ſulphur after deſtillation will onely be obſcured in it's color, and loſe about half a drachm of it's weight. And the remaning water will not eſſentially differ from the firſt.

§ 204. I made the like trials with flowers of ſulphur, one part, alcaline ſalt, two parts, making one a dry ſolution in the form of hepar ſulphuris and diſſolving it in water; and another, an humid ſolution of the ſame proportions in water, by adding to each in ſeparate glaſs alembics in ſand, ſix times their weight of water, and deſtilling them ſlowly, firſt by themſelves, and then with the addition of the vitriolic acid. But, theſe ſucceded no better, and afforded the like products with the preceding. The onely difference obſervable was, that the vapor of theſe tarniſhed clean ſilver yellow, which was not obſerved in thoſe.

§ 205. Theſe experiments and conſiderations, which I layed before the magiſtrates and phyſicians, and which will be further confirmed in the ſequel; leave me no room to ſuſpect, that the waters of Aken contain ſulphur ſubſtantially diſſolved in them, or that the ſulphur, found in the vaults, is the reſult of a natural ſublimation: It's production can not be, in my judgement, accounted for in any other manner, than that of a generation, which is eaſily conceived, when the component parts of ſulphur are demonſtrated in the waters. For any thing, I have yet been able to collect,

collect, from mine own little experience or that of the moſt famed authors, I ſee no reaſon to ſuſpect, there are any waters known, in any other manner impregnated with ſulphur, than this. But, though it were otherwiſe, a perfect ſolution, by the means of a predominant alcali; it is moſt abſurd to look for the ſulphur, as many pretending analyſers do, among the fixed parts, that remane after deſtillation or evaporation: In either way, the ſulphureous principles, or the diſſolved ſulphur will be diſſipated. In the former, it will leave no traces behind it; in the later, the phlogiſton will fly off and let the acid unite with the alcali and conſtitute a neuter ſalt. Whoever then, finds any thing combuſtible after the evaporation of a water, is not to imagine it true ſulphur, before he puts it to the true teſts; nor by any means ſuſpect the ſubtil phlogiſton to remane.

VIII. A further Examination of the Volatile principles in the WATERS of AKEN.

§ 206. Finding the moſt curious parts of this water, and the moſt difficult to be inveſtigated, were the volatile parts, which eſcaped, and for the moſt part, hitherto unobſerved, in the vapor; I applied mine utmoſt care and diligence to get as far as poſſible into this, until now, inſcrutable, ſecret of nature. Having made all the obſervations, that occurred to me on the various effects of the vapor, and the different means, by which the waters are ſpoiled of their volatile parts; I ſought by various methods to collect and condenſe them, if poſſible, in ſome other form, than that, in which they appear in the vaults of the ſources and aqueducts, that of ſulphur. And, though I was not abſurd enough, to imagine, that I could demonſtrate a ſubtil elementary matter, otherwiſe, than by it's effects; I reſolved to ſee what might be obtained by collecting and condenſing the vapor of theſe

waters

waters in proper deſtilling veſſels. I made mine experiments firſt at the Emperor's bath, as the neareſt the great ſource, and then at each of the others; where the heat was ſufficient to raiſe any conſiderable vapor.

§ 207. 1. I began with deſtillation. I took a clean glaſs matrace, with it's head and a bottle for a recipient. I charged the matrace with four pints of water juſt drawn from the conduit of the great bath, which is the next to the great ſource. I placed it quickly in ſand, immediately adapted the head and recipient, and cloſely luted the junctures, with the glare of an egg and flower wrought up to a thick paſte and ſpread upon ſtrips of paper. I lighted the fire and deſtilled ſome ounces of the water. The firſt ounce or two had ſome degree of the fetid ſmell of the bath water, little or no perceptible taſte. And anſwered in weight and effects all the other qualities of common water deſtilled. What remaned in the matrace was now grown turbid, and when cold, ſhewed a terrene ſediment at bottom. It loſſed it's ſmell entirely, and it's taſte was ſimply ſaline and ſomewhat lixivial.

§ 208. Here, I obſerved, the volatile principles, which in this quantity of water, muſt have been but in a very ſmall proportion; had made their eſcape. I repeted the proceſs, with greater caution, if poſſible, placing ſome bits of blew paper, died with the juice of Tournſol, in the juncture of the matrace and head. I drew off about one third, examining it from firſt to laſt; but, diſcovered nothing more, than the blew paper ſlightly ſpotted with red, from the ſubtil acid in making it's eſcape. The firſt deſtillation grew ſlightly milky with a ſolution of ſilver, and made ſome ſlight impreſſion upon clean filings of iron. So that it ſeemed to retain ſome of the acid, though extremely diluted.

§ 209. This experiment not proving very ſatisfactory, I reſolved to collect the vapor, as it roſe from a greater fund, a continual current of the bath water.

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With this intent, I took an earthen matrace, big enough to fill the perforation in the aqueduct, through which the ſteam riſes to ſupply the Vapor-bath. I cut an hole in the bottom of this matrace, fitted it to the perforation, and found the vapor puſhed briſkly through it, while both ends were open. I ſet on the head, and found, that that ſomewhat retarded the progreſs of the vapor. I then, adapted the recipient and luted the junctures, which further obſtructed the proceſs. However, I could ſee a ſlow deſtillation immediately commence, which gave me hopes, I ſhould obtain ſome of the deſired fruits of my labor. As theſe baths were frequented, from four in the morning to nine at night; mine apparatus had not above ſix or ſeven hours in the day to work. I then, ſet it on at nine at night; locked up the door of the bath room, and came to examine it at four the next morning. Then, I found in the recipient, between one and two ounces of a colorleſs water, in which ſeveral little white flocculi, not unlike thoſe obſerved in the water, were aflote. This liquor had much of the ſtrong ſulphureous ſmell of the water, from whence it was drawn; a diſagreeable ſubacid and ſubaſtringent taſte, which made ſome of the phyſicians take it for the water of a little ferrugineous ſpring in the town, upon taſting it. To me, in ſmell and taſte, all to a little auſterity, it much reſembled Purſlain water. It's ſmell and taſte convinced me, it contained ſome of each of the volatile principles. I judged it to be a kind of ſulphureous Gas, a liquor impregnated at leſt with one of the component parts of ſulphur, and not quite free from the other; ſo I proceeded to examine it by the following, among other experiments.

§ 210. 1. In weight, it differed not from common deſtilled water.

§ 211. 2. With the mineral acids, it ſuffered no ſenſible alteration or commotion.

§ 212. 3. With the fixed and volatile alcalies, in

a liquid ſtate, it was not ſenſibly altered; except in it's ſmell, which was highthened thereby; but,

§ 213. 4. With theſe alcalies concrete, not onely this effect was more ſenſibly produced, but a ſlight ebullition aroſe upon mixture, not much more however, than in common deſtilled water.

§ 214. 5. For ſome hours, it wrought no ſenſible change in ſirup of violets, but dilution of conſiſtency and color; but, afterwards, it ſtruck a roſe purple.

§ 215. 6. Poured upon clean filings of iron in a glaſs, a motion of ſolution immediately commenced, and little light air bubbles appeared upon the iron, and as they ran together, aroſe and eſcaped at the ſurface; when common deſtilled water poured in the ſame manner and proportion on iron, had no viſible effect.

§ 216. 7. Solution of mercury ſublimate, four drops to half an ounce of this vapor water, cauſes a milkineſs.

§ 217. 8. Solution of ſilver, the like quantity, cauſes a milkineſs, with the color of Moſel wine.

§ 218. 9. Solution of lead in deſtilled vinegar, from two to five drops, cauſes a milky opacity, attended with a ſudden coagulation and precipitation, with a muddy color, ſuch as ariſes upon dropping this ſolution into newly drawn thermal water.

§ 219. Theſe all, except the ſecond, give demonſtrative proofs of the exiſtence of the aſſerted principles in the vapor; to wit, the ſulphureous acid and the phogiſton. To the former, the commotion with the dry alcaline ſalts, the change of color in the ſirup of violets, the actions upon the filings of iron, and the precipitation of the metals are owing; but, the ſmell, the milkineſs with the mercury ſublimate, the Moſel wine color in the precipitation of ſilver, and the muddineſs in that of lead; each of which had otherwiſe been white, moſt certainly ariſe, from the later; as ſhall be further evinced in examining the

water

water with theſe ſolutions. This volatile acid is the cauſe of the various ſolutions before mentioned: It is this, that corrodes the iron and lead, produces alum, with certain ſtones, and, with the phlogiſton, ſulphur. It is this, that diſſolves the earth, found in the water; and which upon the diſſipation of this acid, upon lying expoſed to the open air, upon deſtillation or evaporation, or upon ſaturation of this acid with alcalies, ſeparates in milkey clouds; precipitates or incruſts the ſides of the veſſels, in which it lyes, with a ſtony concretion.

§ 220. It may not be amiſs to cloſe this branch of our ſubject, with ſhewing the remarkable effects of this vapor upon lead expoſed to it's ſtrongeſt force.

§ 221. A piece of bright ſheet lead, ſuſpended in the vapor of the water, that ſupplies the vapor baths, in a few hours, is ſlightly tarniſhed to the color of ſteel, purpled by fire. In twelve hours, the color is at the deepeſt, and ſome particles of a blackiſh matter, which appears to be partly diſcolored ſulphur, adhere unequally to the ſurface. Upon rubbing the lead, it gives the finger an inkey blackneſs, very hard to be waſhed off. Upon waſhing the lead, a conſiderable quantity of this fine, ſubtil, black powder ſeparates and ſubſides. Having waſhed it clean, and given it another bright ſurface by ſcraping, I hung it again for twenty four hours in the vapor. It was in part highly tinged or tarniſhed as before, partly covered with a black powder and partly interſperſed with little, bright ſilver-white, ſhining globules, which every body, at firſt ſight, took to be globules of mercury. Being viewed through a double convex lens, it had the ſame appearance; ſo that, after this, few doubted it's being mercury, and ſome were ſo ſure of it, as to attempt to account for it's coming there. But, upon cloſer examination, even by ſlightly rubbing, it appeared to be a ſolution or kind of corroſion of the lead by means of the ſubtil acid and the phlogiſton. It run into a black powder of extreme

treme tenuity, upon rubbing. The like effect is produced when to lead, diſſolved, or corroded by an acid, any ſubtil ſulphureous liquor is added, or a volatile ſpirit impregnated with ſulphur, or phlogiſton, even the fumes of charcoal, are admitted. Thus, wine, or any other liquor, adulterated with lead, is diſcovered by dropping a ſolution of orpiment or yellow arſenic in lime water into it; which inſtantly turns it black. The ſame is done by dropping this ſolution of arſenic or HOFFMAN'S volatile tincture of ſulphur into any liquor charged with lead. If a ſpoon or ſaucer, wet with a ſolution of ſugar of lead, or a plate of lead corroded with any acid fumes, be held over the vapor of this tincture, or a few drops of it be let fall upon the ſurface wet with the ſolution of lead, or that of the corroded lead, it will either gradually change to a dark brown, or inſtantly grow coal black, and ſoon after, put on a ſurface like lead amalgamated with quickſilver.

§ 222. By this means, the above phaenomena of the plate of lead in the vapor of the thermal waters, may be accounted for; as alſo may the diſcoloration, that ariſes in the precipitation of a ſolution of lead in the collected and condenſed vapor, as well as in the water, before the volatile principles are loſſed: For, after they are ſpoiled of theſe principles, the precipitate of lead is of a ſnowy white; as ſhall be proved in the ſequel.

§ 223. The nature of this vapor thus explained and conſidered, it's effects, inwardly taken or outwardly applied, may the more eaſily and fully be conceived. But, of it's medicinal qualities, in the proper place; after we have firſt determined the other conſtituent parts of the water, by the proper experiments.

IX. *Of the other component parts of the* AKEN *Waters.*

§ 224. The water of the great ſource, or that of the fountane and adjacent baths, when taken up clear,

and

and ſtopped cloſe in clean bottles till cold, an empty ſpace appears in proportion, as the water was rarefied by heat, and is now condenſed by cold. If this empty ſpace be filled with ſome of the cooled water, it will keep clear and bear carriage without any loſs, but that of heat, that the ſenſes can diſcover. But, experiments go further, and ſhew the loſs; as will appear in the ſequel; when we come to compare the effects of various mixtures upon the hot water and upon the cold; that is, upon the thermal water of its natural heat, and the ſame cold, that is, ſet to cool in bottles filled and cloſe ſtopped with cork, and ſet by for eighteen or twenty hours in a cold place.

§ 225. To theſe, I ſhall compare the ſame water ſpoiled of it's volatile, and in a great meaſure, of it's terrene parts, by deſtilling or evaporating it to the abſumption of about one ſixth. This is meaned, where I hereafter ſpeak of evaporated water.

§ 216. As I found ſome authors[a] of credit, and ſome reputable practicioners, eſpecially here in Britain, unaccountably poſſeſſed with a notion, that Aken waters, as well as thoſe of our Bath, were impregnated with iron, as well as ſulphur, and that thoſe of Bath contained ſulphur, as well as iron; I ſet about determining the important queſtion, with all care and caution; determined to take nothing upon truſt. My firſt experiments then, were in ſearch of this iron in the waters, which was firſt to be indicated by different dying matters, whoſe effects are well known.

§ 217. 1. Firſt, I took five granes of galls in pretty fine powder, I threw it gradually into an ounce of the thermal water.—No change appeared, but a muddy, milkey infuſion. In twelve hours, a light mother of pearl-colored pellicule appeared on the ſurface, under which, the liquor was of an obſcure green. The powder of galls fell to the bottom; while a thick, white, cloud was ſuſpended about the middle. In

[a] BERGER and HOFFMAN, in books cited.

twenty

twenty four hours; this cloudy coagulum ſubſided, and left the ſupernatant liquor of a deep, muddy green.

§ 218. 2. The ſame proportions produced the like appearances in the cold water, in an inferior degree; that is to ſay, neither the milkineſs at mixture, nor the cloud were ſo conſiderable, as in the hot, and they ſubſided ſooner. But, the liquor ſeemed of a much more intenſe green.

§ 219. 3. The ſame was tried with the ſame quantity of the powdered galls and the evaporated water; with ſtill ſtronger appearances, than in the firſt; ſuch as a milky, ſtraw-color upon mixing. In twelve hours, it appeared very turbid and cloudy; the upper part of the liquor, of a yellowiſh or goſling green. In twenty four hours, the clouds were more ſubſided and the liquor appeared of a dark, graſs green.

§ 220. 4. But, leſt the powder of the galls ſhould, as it ſometimes may, obſcure the liquor, ſo far, as to render the change of color imperceptible; the like experiments were made with an infuſion of galls in hot deſtilled water, one drachm to four ounces; and this ſhewed none other color, than the powder.

§ 221. 5. The like experiments with green tea, ſerved onely to heighten the color to a yellowiſh green.

§ 222. 6. The firſt experiment was repeted with five granes of powder of rhubarb to an ounce of the water. It remaned a minute or ſo, of a gold color, and then began ſenſibly to improve to a ſaffron color, which gradually highthened to a kind of red; as when an alcaline ſalt is thrown into an infuſion of rhubarb. In about twelve hours, it got to the color of London butt beer, with a pellicule on the ſurface, at the edges of which, the glaſs was coated with the coloring matter.

§ 223. 7. Rhubarb in the ſame proportion to the evaporated water, inſtantly ſtruck a ſaffron color, which gradually roſe to an high orange color. In

twelve hours, the dye was ſo ſtrong, as to make the liquor appear opac. But, examined between the eye and the light, it appeared clear, though moſt extremely high colored.

§ 224. 8. Rhuburb in the like quantity of the cold water, ſtruck firſt a gold color, and ended in an amber color.

§ 225. 9. I made theſe ſeveral trials with rhubarb in infuſion, one drachm to four ounces of deſtilled water, upon the ſame waters, and the like effects were produced.

§ 226. 10. Dried, red roſes, twenty grains infuſed in one ounce of the water, for ſome time wrought no ſenſible change. In two or three minutes, it got a yellowiſh tinge; and in about twelve hours, the roſes loſſed their color, and the water was dyed of a pale yellow or kind of ſtraw color. But, upon ſtanding ſome hours longer, it highthened to ſome ſhades of deeper yellow, near an orange color.

§ 227. 11. In the evaporated water, the ſame flowers inſtantly ſtruck a lovely, pale, graſs green. But, in about twelve hours, it became a deep yellow, inclining to an orange color. For further aſſurance, I repeted theſe experiments, with a ſtrong infuſion of roſes in deſtilled water. This was of a Burgundy wine color; but, with the waters, it turned to a greeniſh yellow.

§ 228. Theſe experiments all agree in proving, That there is not a particle of iron in the waters. If there were, it would appear, 1. either in a pellicule of various colors on the ſurface of the water; or, 2. In the ſediment of the evaporated water, which would be of ſome ſhade of the red, brown or ochre color; as BERGER and HOFFMAN ſuſpected; for they had never ſeen Aken, or they certainly could not have made the miſtake before mentioned; or, 3. In dying ſome ſhades of black, blew or purple, with the galls, or tea, or a compound of different ſhades of black and yellow, which conſtitute a kind of olive or yel-

low cryſtal color, with the rhubarb and red roſes. But, the effects were quite different, and ſuch as ſhew us, that the thermal water, in the natural ſtate, is neuter; but, that as it loſes it's volatile principles, when there is nothing added to arreſt and retain them; by ſtanding, as well as evaporation, an alcaline ſalt becomes predominant in them, and produces the different changes obſerved in theſe ſeveral trials. This is further evinced by the following experiments;

§ 229. 12. Paper dyed with juice of tournefol of a beautiful bright blew color, immerged in the thermal water, changes quickly to a deep violet color, and in about three minutes, gives the water the ſame tinge. In about twelve hours, the color is much highthened; but more upon the blew, than the purple; or more of the violet color, than of that of the roſe.

§ 230. 13. In the evaporated water, the ſame change more ſuddenly and ſenſibly.

§ 231. 14. In the cold, the like effects, but moſt ſlowly.

§ 232. Here, it appears, that the compound color firſt ſtruck, to wit, that of the violet, which conſiſts of different ſhades of red and blew, ariſes from the portion of the volatile acid blended with the water: For, as this acid flies off or is expelled, the ſimple blew is reſtored and highthened.

§ 233. 15. If any vegetable acid, deſtilled vinegar, as the moſt colorleſs, for inſtance, be dropped upon this blew paper, it ſtains it of a pale red color.

§ 234. 16. If this ſtained paper be immediately dipped in the thermal water, it will ſoon be reſtored; but ſtill ſooner in the evaporated water.

§ 235. 17. This does not ſuccede ſo well with the mineral acids; unleſs a ſtream of either water be poured on and off it; otherwiſe, if the quantity of water be but ſmall, the whole paper, as well as the ſpots made by theſe acids, will be changed to a red.

§ 236. 18. Sirup of violets, two drachms to one ounce of the thermal water, is not at firſt mixing changed,

changed, which has made ſome curſory experimenters pronounce, that it is not changed by the water. But, had they attended properly, they muſt have found what gives great help to acquiring a juſt knowledge of the water; at firſt, indeed, it ſuffers no change, but dilution of conſiſtency and color; but, in about a minute, it becomes a ſea green, which highthens every minute, as it ſtands; till, in about an hour, it becomes a beautiful bright green, and in about twelve, changes to a ſad green.

§ 237. 19. The change is much ſlower with the cold water, and the color never becomes as deep, as in the hot.

§ 238. From theſe, it is plane, that the water is in a neutral ſtate, whileſt it retains it's volatile principles. Theſe, the hot loſes faſter, than that, that cooled cloſe covered. In proportion then, as the acid exhales, it recedes from it's neutrality; the alcali predominates, and turns the blew ſirup green. This is further evinced, by reſtoring an acid to a certain point to the green mixture, by which the priſtine color is again revived. An other proof, that it is the loſs of the acid, that cauſes the change of the blew to a green color, is taken from the following experiment;

§ 239. 20. The ſame quantity of ſirup, to one ounce of the evaporated water, turns inſtantly to a pale green; which, upon ſtanding a few minutes, improves to a lovely deep green. In about twelve hours, it becomes a ſad, graſs green.

§ 240. This color may alſo be turned to it's former color, by the addition of what the water loſſed in the evaporation, an acid.

§ 241. 21. Campechy wood or log-wood, ſix granes infuſed in one ounce of the thermal water, ſtrikes a fair Burgundy wine color, with ſome ſhades of crimſon on the ſurface.

§ 242. 22. Still quicker and deeper dyed in the evaporated water.

§ 243. This is the effects of lixivial ſalts; and had there been ever ſo little iron in it, it muſt have changed to a purple or deep blew.

§ 244. 23. Cochinell bruiſed, three granes infuſed in one ounce of the water, gives an high ſcarlet, with ſome ſhades of deep crimſon towards the ſurface.

§ 245. This ſtrengthens former experiments and obſervations. We come now to ſome further proofs of an acid and an earth in our waters, by the means of alcalies.

§ 246. 24. Upon dropping five drops of alcaline ley, that of tartar for inſtance, into an ounce of the thermal water, it got a blewiſh caſt, as if milk had been dropped into it. This milkineſs was increaſed almoſt to an opacity, at twelve drops. In about twelve hours, all the terrene parts were ſubſided to the bottom and ſides of the glaſs; where they ſeemed to adhere, leaving the water clear and pellucid.

§ 247. 25. Eighteen drops of the ley made an ounce of the cold water foul or turbid, not milkey. Several flakes appeared to flote in it, which more ſuddenly ſubſided, than in the hot.

§ 248. Here effects, ſimilar to that of evaporation, are produced: In the later, the acid is diſſipated; here, it is ſaturated with that, with which it has a more powerful attraction, a fixed alcali. In either caſe, the earth is ſeparated and muſt ſubſide. The ſlow effects in the cold compared to the hot water, may be partly owing to ſome loſs of it's acid, partly to it's being more at reſt, whence the precipitation was more grumous. That the milky or turbid ſeparation of terrene parts in both ariſes from the loſs or ſaturation of the acid is proved by the following experiments;

§ 249. 26. No viſible change is wrought in the evaporated water, by any quantity of the alcaline ley.

§ 250. The reaſon for which is evident: By evaporation it's acid is already diſſipated, and it's earth ſeparated. The alcali can do no more.

§ 251. 27. The dry fixed alcaline ſalt, that of tartar for inſtance, has another effect. I threw four granes of a pure fixed alcali into one ounce of thermal water. An ebullition immediately enſued, which continued, until the laſt particle of the ſalt was diſſolved. Mean while, the water grew milky and turbid; but, in about twelve hours, was cleared again by the precipitation of the terrene parts, as with the liquid alcali or ley of tartar.

§ 252. This gives, at the ſame time, proofs of an acid, as well as of terrene parts in the water. The ſame ſuccedes in the cold water alſo. The ſeparation and precipitation is in that likewiſe more ſudden. But, we are to be cautious in reſting too much upon this ebullition upon mixture with dry alcalies, fixed or volatile, alone, as a deciſive proof of the exiſtence of an acid in the waters; becauſe the degree of heat, given by the one, and that of cold, cauſed by the other, is to be taken into the eſtimate; ſo that this alone is not to be relied upon, where there is not other concurring evidence.

§ 253. 28. The volatile alcali in a liquid form, that is, ſpirit of ſalt ammoniac, produced effects analogous to the alcaline ley; but, required twenty drops, and cauſed a more light and ſubtil precipitation: For the like reaſon with the preceding.

§ 254. 29. In the evaporated water, it had none effect, more than the ley, and for the ſame reaſon.

§ 255. 30. The volatile alcali concrete, that is, volatile ſalt ammoniac, produced effects analogous to thoſe of the fixed alcali concrete, and for the ſame reaſons.

§ 256. In the ſeveral experiments, from 25 to 31 incluſive, we have demonſtrative proofs of an acid and an earth. In theſe, the reſult of the ſaturation might have been examined apart, with theſe ſeveral

alcaline ſalts, to ſhew the kind of neuter ſalts, that ſhould ariſe, in order to determine the nature of the acid; but, that is already ſufficiently done [a]. The earth, together with the native ſalts of the water, ſhall be examined in their reſpective places. We now procede to ſhew the effects of various acids on this water.

§ 257. 31. The acid, called oil of vitriol, fiveteen drops gradually dropped into an ounce of the thermal water, at every drop, cauſed a ſenſible, ſtrong ebullition in the water; even when the acid was become predominant in the mixture. It became exceeding clear and pellucid, and preſerved it's brightneſs for many hours.

§ 258. 32. Even in the cold water, this cauſed an ebullition, as far as twelve drops, no more, and reſtored and preſerved its pellucidity, with ſome effervescence, which raiſed the mercury four degrees in the ſmall thermometer.

§ 259. 33. In the evaporated water, the effects were quicker and ſtronger than in the recent thermal. It's brightneſs was completely reſtored and preſerved.

§ 260. 34. The acid, called ſpirit of vitriol, which is commonly the oil diluted with three parts water, produced a ſenſible ebullition, from the firſt to the twelveth or thirteenth drop. I added fiveteen, none other change aroſe. The water was rendered more pellucid, and continued ſo many hours.

§ 261. 35. In the evaporated water, a quick and ſtrong ebullition, from the firſt to the laſt drop, enſued, which perfectly reſtored and preſerved it's pellucidity.

§ 262. 36. In the cold, it cauſed no ſenſible commotion; no change, but the anguillary motion of mixing an heavier with a lighter fluid; but, it increaſed and preſerved its pellucidity.

§ 263. 37. The ſimple acid of nitre, vulgarly called aqua fortis, cauſes an apparent ſtrong ebullition; as

[a] § 185, to 192, &c.

far

far as twelve drops to an ounce of the thermal water. The mixture ſhewed bright and pellucid for ſeveral hours after.

§ 264. 38. In the cold, it cauſed no viſible commotion; no change, but the anguillary motion upon mixture. Upon ſtanding ſome hours, it was not to be diſtinguiſhed from the glaſs, in which the drops were inſtilled hot; both were alike bright and pellucid.

§ 265. 39. But, in the evaporated water, a very quick and ſtrong ebullition was raiſed from the firſt, as far as ſixteen drops, and it's brightneſs moſt perfectly reſtored and preſerved.

§ 266. 40. The acid, called Spirit of Salt, weak and pale, eighteen drops, to one ounce of the thermal water, cauſed the like effects, the ebullition rather ſtronger than with the above-mentioned nitrous acid.

§ 267. 41. In the cold water, it likewiſe produced the like effects, as the nitrous acid.

§ 268. 42. And in the evaporated water, ſtill the ſame effects, rather more ſtrong and ſenſible, than with the acid of nitre. But this, I attribute onely to the different degrees of concentration or dilution of theſe acids.

§ 269. Whoever would have a ſolution of the phaenomena, which appear in theſe experiments, muſt look into the General Idea of Salts and their different relations to each other, premiſed in this eſſay. Then, let it be conſidered, that it has already been made to appear, that this water contains the inflammable principle and a volatile acid ſpirit. This acid is not onely blended with the water, but, in ſome meaſure, united with the other ſalts, as well as with the earth, which, by the means of the acid, is diſſolved in the water. By this union, the water becomes a ſeeming neuter fluid; but, as the volatile acid eſcapes in the open air, the lixivial parts become predominant, and alcaline effects are produced. Upon the adding any of theſe mineral acids, the abſorbent earth and alcaline ſalts are ſaturated with an heavier acid,

one, which has a ſtronger attraction with them, than the volatile acid; whence, this is expelled, whileſt theſe take it's place, and form a different combination, as is explaned in ſhewing how the acid of ſea-ſalt is drove from its alcaline baſe, by that of nitre, as both are expelled their baſes by the acid of vitriol. See the General Idea of Salts, § 81. and following to § 86. However, we muſt be cautious not to pronounce any water impregnated with an alcali, upon barely ſeeing an ebullition raiſed with the concentrated mineral acids, eſpecially that of vitriol; becauſe theſe, like the fixed alcali, particularly the later, cauſe ſome degree of efferveſcence with the ſimpleſt water.

§ 270. But, the natural acid of the waters of Aken is not onely more light, more ſubtil and volatile, than the artificial mineral acids; but, it excedes even thoſe of the vegetable kingdom in theſe qualities; as appears by the following experiments;

§ 271. 43. Juices of lemmons, oranges, red and white corinths, berberries and the like, cauſe a ſenſible, ſmart ebullition, upon dropping into the thermal water of the native heat.

§ 272. 44. In the cold water, they produce the like effect, leſs ſenſibly. And,

§ 273. 45. In the evaporated water, ſtill the ſtrongeſt of any of the three.

§ 274. 46. The fermented juices and infuſions of vegetables, thoſe eſpecially, that have any remarkable acidity or tartneſs, produce the like effects in the hot, cold and evaporated waters. Cyder, and beer, moſt wines, the red and the white wines of France, and theſe of Moſel and the Rhine eſpecially. Even the ſpirits drawn from theſe fermented liquors, good old brandy, for example, all give evident proofs of their containg a groſſer acid than that of this water, by cauſing an ebullition upon mixing with it; which ariſes from their attracting the abſorbent and alcaline ingredients of the waters, and propelling the more ſubtil acid.

§ 275.

§ 275. 47. After theſe, it would be needleſs to ſay that vinegar has the like effect, as it muſt by all be taken for granted; were it not, that a ſingular phaenomenon ariſes upon mixing deſtilled vinegar with this water, which merits attention.

§ 276. 48. Upon dropping twenty drops of deſtilled vinegar into an ounce of water, a ſmart, ſtrong ebullition aroſe, with a ſeeming milkineſs. Upon inſtilling more, and further agitation, it ſeemed ſaturated, at about forty drops; when, with a milky hue, it recovered it's original color, that of white wine, or white wine vinegar. After ſtanding about twelve hours, it appeared full of clouds of a darker color, approaching to a brown and ſeeming earthy; leaving the ſupernatant fluid pellucid and colorleſs.

§ 277. 49. In the cold water, there was none ebullition or commotion perceptible; but, the milkineſs, and revivification of color enſued, with the cloudy precipitation.

§ 278. 50. In the evaporated water, there was a ſtrong ebullition, eſpecially upon agitation. But, no milkineſs, no change of color, no precipitation or cloud enſued, even upon long ſtanding.

§ 279. 51. The like effects were produced, but in an inferior degree, with deſtilled vinegar and the waters of the ſeveral other baths, that derive their waters from the great ſource.

§ 280. 52. In the waters of the ſources of the fountane and the adjacent baths, the ſame commotion was produced with the deſtilled vinegar, as in the preceding; but, little or no change of color or precipitation.

§ 281. The contraſt and ebullition, upon mixing this fermented vegetable acid with the waters, are accounted for, as thoſe of other acids with the ſame liquor; but, the change of color ſeems to me entirely to ariſe from the inflammable principle; and the ſubtil acid of the vinegar. It is well known to chemiſts, that the pureſt fixed alcali, ſuch as in diſſolving imparts no color to the faireſt water, being ſaturated with

with the pureſt and moſt colorleſs deſtilled vinegar, gets a conſiderable tinge of a brown color: Becauſe, the vegetable fixed alcali is hardly, if at all, to be freed from the inflammable principle; the mineral alcali's being void of this principle is the reaſon, why no change of color ariſes upon ſaturating the evaporated water [a] with this acid. This is further confirmed by finding, the three waters, which upon other trials, appear moſt ſtrongly impregnated with the phlogiſton [b], give a remarkable color with the deſtilled vinegar; whileſt theſe, that are found to yield leſt [c], give little or none; and thoſe diveſted of their phlogiſton by evaporation [d], none at all.

§ 282. By theſe experiments, we ſee the remarkable changes wrought in theſe waters, by all the acids, as well vegetable, as mineral. In the conflict, raiſed upon mixture, all the air of the waters, all their fine, ſubtil, exalted ſpirit muſt be expelled, and a new and different combination produced. Hence, proper cautions for diet, and other regulations, are to be drawn: For, the operation and effects of the water muſt greatly depend upon the nature of thoſe aliments, or other matters, they meet in the firſt paſſages. We have, by theſe experiments, ſeen the different changes, that are wrought in theſe waters, by alcalies and acids. And, till a phyſician can find means of accounting for, or at leſt, aſcertaining, the effects, ſuch mixtures muſt produce on the human body; he ſhould not preſcribe ſuch things to be mixed with the waters or taken during a courſe of them, as muſt work a ſenſible change in their nature and operation. I repete this caution and the more earneſtly recommend the obſervance of it; becauſe, I have frequently known a moſt incongruous diet preſcribed or admitted, and moſt incoherent, abſurd medicines directed to be mixed or taken with a courſe of theſe and many other mineral waters; ſuch as muſt produce effects diametrically oppoſite to the natural properties and effects of the waters; and this, for

[a] § 272. 50. [b] § 279. [c] § 280. [d] § 278.

want

want of ſuch experiments, as might convey rational ideas of them. And thus, the fountanes of life and health, are rendered by perverſion, the ſources of death and deſtruction!

§ 283. Let us now enquire what effects the mineral ſalts and metallic ſolutions produce upon mixture with theſe waters, in order to give a further idea of their conſtituent parts.

§ 284. 53. All the neuter ſalts, with vegetable alcalies and acids, diſſolve and mix, as in ſimple water, without making any ſenſible change in the thermal waters.

§ 285. 54. The mineral neuter ſalts, for the moſt part, diſſolve and mix in the like mannner; ſuch as ſal Gem, ſea ſalt, Borace, ſalt ammoniac; and ſalt peter, whoſe baſis is a fixed, vegetable alcali, united with a mineral acid. But,

§ 286. 55. Salt ammoniac thrown into the evaporated water, is partly decompoſed; as appears by an urinous ſmell ariſing from two bodies, before mixture, inodorous. This argues an alcali predominant in the waters after evaporation, or the loſs of their volatile parts, which kept them neuter, while they remaned united in due proportion. But, the one having been, in the evaporation, exhaled, the alcaline parts are left free to act upon the ſalt ammoniac; whoſe volatile parts are ſet at liberty by it's acid's attracting, and uniting with, the mineral alcali in theſe waters.

§ 287. 56. A ſolution of alum dropped into the new drawn water, cauſes an ebullition, to about the thirtieth drop, with a milkey coagulation; which, upon agitation, appeared diffuſed throughout the whole liquor, and upon ſtanding eight or ten hours, is moſtly, looſely precipitated, of a bright pearl-color.

§ 288. 57. The like effects are produced in the cold water; but, without any ſenſible ebullition, and with a more looſe and imperfect precipitation.

§ 289.

§ 289. 58. In the evaporated, the ebullition ceaſes, not, before thirty ſix drops are added. The milkineſs is rather greater and the ſeparated parts are much more ſlowly and looſely depoſited.

§ 290. It has already been obſerved, that alum conſiſts of a peculiar abſorbent earth and the vitriolic acid. By theſe experiments, we ſee the water contains ſomething capable of decompoſing this concrete; to wit, an alcaline ſalt, which we ſhall prove to be of the mineral tribe, and which, attracting and being attracted by, the vitriolic acid, unites and forms another neuter ſalt; to wit, that of Glauber. Here then, is a double decompoſition: The fixed acid of the alum changes it's terrene, for a ſaline baſe, and in the hot water, expels and uſurps the place of it's native acid. This, at the ſame time, that it helps to clear our ideas of the conſtituent parts of theſe waters, ſhews what a miſtaken notion it is to attribute alum to the compoſition of this water, or to admit it in any form to be taken during a courſe of them. The reaſon of the coagulum's not being precipitated, as well, or as ſoon, in the evaporated, as in the new-drawn water, will appear upon conſidering, that the medium is rendered thicker, in the evaporated water, through which the precipitate is to paſs; whence, it muſt, of courſe, more ſlowly ſubſide. This will hold good in all precipitations in that liquor: The rule in chemiſtry for making the beſt precipitate is firſt to dilute well the ſolution; without which, the precipitate will be ſlowly formed, as well as groſs and imperfect.

§ 291. The ſeveral metallic ſolutions give us ſome uſeful evidence of truths relative to this ſubject; as for example;

§ 292. A ſolution of quickſilver in the acid of nitre, if not diluted, will cryſtalliſe. The ſolution may be uſed as one of the teſts of waters, upon the principles layed down under the general idea of ſalts; and Trials and choice of ſimple water; but, the parts which run into cryſtals being diſſolved in deſ-

tilled

tilled water, yield ſtill a more ſenſible teſt. I ſhall here give the effects of each.

§ 293. 59. The ſolution of quickſilver cauſes an ebullition, as faſt as the drops fall into it, from the bottom to the top, as far as about twenty drops to an ounce of the new-drawn water. This heavier liquor, whileſt it lyes unmoved at bottom, works none other ſenſible change there; but tinges that, through which it falls, ſomewhat milkey. Being agitated, it contracts a blewiſh, milkey hue all over; but, upon ſtanding a few hours, a pure white precipitate in an inconſiderable quantity ſubſides; leaving the ſupernatant liquor clear and pellucid.

§ 294. 60. In the cold water, this ſolution produces all the ſame effects; except the ebullition.

§ 295. 61. In the evaporated water, it had all the effects in an higher degree, particularly the ebullition, which ceaſed not, before thirty drops were added; but, the precipitation was more ſlowly and imperfectly performed, as the liquor was rendered thicker and heavier by evaporation.

§ 296. 62. The ſolution of the cryſtals of mercury produces other and more ſenſible effects; Pale yellow, opac clouds are cauſed by every drop. Theſe quickly ſubſide of a muddy lemon color. Over theſe, a very white, tranſparent, light cloud appears. The ſupernatant liquor retains a yellowiſh tinge.

§ 297. 63. In the cold water, nearly the like effects follow upon the inſtilling this ſolution. The clouds rather more pale and bright, and the ſubſidence ſomewhat more ſlow.

§ 298. 64. But, in the evaporated water, the clouds and precipitation are more thick and ſudden, and of a pale or milky white; little or no yellowneſs remaning.

§ 299. 65. A ſolution of corroſive ſublimate of quickſilver in diſtilled water ſhewed no ſenſible change, till about twenty five dropps were inſtilled into an ounce of the thermal water. Then, it appeared more milky, than the mixture with the ſolution of quick-

ſilver

ſilver. In ten or twelve hours, a bright pellicule variegated with all the colors, covered the ſurface; at the edges of which, the glaſs was coated with a whitiſh precipitate. A grumous, or as it were, a granulated white precipitate adhered to different parts of the ſides; while a yellowiſh, aſh-colored matter fell in clouds towards the bottom, leaving the reſt of the liquor clear.

§ 300. 66. This experiment ſucceded alike with the cold water; the clouds rather paler.

§ 301. 67. In the evaporated water, the like proportion of the diſſolved ſublimate, cauſed a much more conſiderable milkineſs, than in the hot or cold. Upon ſtanding, it ſhewed a fair bright pearl color; after which, a pale mother of pearl-colored pellicule roſe on the ſurface; where the glaſs was coated white; while an inconſiderable quantity of a light, white precipitate fell to the ſides and bottom.

§ 302. 68. A ſolution of lead in deſtilled vinegar, or, of ſuggar of lead in deſtilled water, fiveteen drops to an ounce of the thermal waters, turns it at dropping of a muddy milkey color. Then, an heavy grey or aſh-colored precipitate ſubſided; leaving the liquor of a muddy pale brown, or dark aſh-color. Upon ſtanding ſome hours, an heavy, dull white powder is fairly precipitated, leaving the ſupernatant liquor quite clear. If the ſolution be dropped in and all ſuffered to ſubſide without agitation, all appears at firſt of a muddy pale brown; and when the precipitation is formed, it will ſhew two different colors; to wit, a dark aſh or ſlate color, on the upper part, underneath, a greyiſh white.

§ 303. 69. This ſolution produces ſimilar effects on the cold water; except, that the ſeveral precipitations are conſiderably whiter. So ſenſible is this change, that the difference is perceptible between the precipitate made inſtantly as the water is drawn from it's ſource, and that made with water lying twenty ſeconds in a bottle filled and cloſe ſtopped. I diſcovered this ſurpriſing alteration, partly by accident.

As I repeted all mine experiments ſeveral times, as well at the ſource, where I firſt made them, as in my chamber in the Emperor's bath and others; I ſent my ſervant with a clean empty bottle for water to the ſource. He firſt dipped it in and rinced it with the water to heat it, then filled the bottle quick as poſſible, by immerging it in the ſource; he corked it as readily, and brought it up ſtairs to my chamber in eighteen or twenty ſeconds. Upon dropping the ſolution into ſome of this, I ſaw ſuch an abatement of color, ſuch a whiteneſs, as ſurpriſed and made me ſuſpect ſome miſtake. I could not be ſatisfied, till I made the experiments on each together at the ſource; firſt on the water juſt taken from the ſource, and then upon that, which had been not above eight or ten ſeconds in the cloſe-corked bottle, and ſaw the wonderful difference and judged whence it aroſe; as I ſhall further explane in it's place. To this, the following experiment greatly conduced.

§ 304. 70. As faſt, as the ſolution is dropped into the evaporated water the mixture appears of a bright, ſnow-white, all over; and ſoon after, a light and exceding white precipitate ſubſides. In ſome hours, the precipitation is found complete, without any perceptible diverſity of color.

§ 305. 71. A ſolution of ſilver, in the acid of nitre, twelve drops to an ounce of the thermal water; every drop cauſed a remarkable, thick, white cloud, which ſoon after formed a milkey or creme-like coagulation, and changed color, firſt to a yellow, and after, to a brown; then, coaleſced in large grumes or flakes, part of which was thrown up by a ſeeming inteſtine motion, an ebullition, which could not be planely diſtinguiſhed; becauſe of the opacity of the mixture; this floated on the ſurface of a milky or cremy white, greatly reſembling creme curdled in bohea tea. In a ſhort time, theſe grumes or flakes coaleſcing ſubſided; leaving the ſupernatant liquor like muddy beer whea. In about twelve hours, very little

of

of theſe flakes is found on the ſurface; the precipitation is diſtinctly formed; at the bottom, it is white, or of a creme color; over that, it is of a pale brown or dark aſh-color. The ſupernatant liquor, quite colorleſs and bright.

§ 306. 72. In the cold water, all theſe effects, except the inteſtine motion and dark color of the precipitation, were produced; all the varieties of color, that aroſe, were ſeveral ſhades paler, than thoſe in the new-drawn thermal water. And all theſe were wrought in the like proportions and upon the ſame principles, as ſuch changes appeared with the ſolution of lead in the [a] new-drawn, and ſome time kept waters of the ſame bath.

§ 307. 73. In the evaporated water, this ſolution cauſes a ſudden coagulation with an inteſtine motion, which renders the whole opac. This coagulation is very white and ſoon ſubſides in form of a fair white precipitate; ſhewing no diſcoloration of the water, but a milkineſs. Upon ſtanding a few hours, the precipitation was complete, the liquor bright and colorleſs. The precipitate was exceding white at the bottom; but had a ſhade of aſh-color on the ſides and upon the upper part of the precipitate at the bottom of the glaſs.

§ 308. 74. A ſolution of blew vitriol, in deſtilled water, at every drop, cauſes a blewiſh, milky cloud in the thermal water; by a few, it is rendered opac. Upon ſtanding, a pale, verdigriſe-green precipitate ſubſides.

§ 309. 75. It produces the like effects, more ſlowly, in the cold.

§ 310. 76. In the hot, the like effects more quickly enſue; but, the precipitation more ſlowly and imperfectly.

§ 311. 77. A ſolution of green vitriol in deſtilled water, at every drop, renders the thermal water milky

[a] § 302, 303.

and

and muddy. Upon ſtanding, it coagulates into little ſeeming grumes or clouds of a pale yellow color, which afterwards ſubſide and give an ochrous earth.

§ 312. 78. The like effects, but more ſlowly, ſuccede the dropping this ſolution into the cold water.

§ 313. 79. In the evaporated, the milkineſs and coagulation are quicker and greater; but, the precipitation, more ſlow and imperfect.

§ 314. At the[a] firſt ſight of theſe ſeveral experiments, it appears, that theſe waters contain ſomething capable of decompoſing all the metallic ſolutions in acids. This may be done various ways, as by abſorbent earths and alcaline ſalts, in moſt; as well as by the principles of ſulphur, the phlogiſton and the univerſal acid, as well as by ſea ſalt and it's acid. Till then, it be otherwiſe determined, what the nature of theſe ſeveral precipitates are, or by what they were produced; little can be drawn with certainty from the bare effects of precipitation. But, to give ſome account of theſe among other effects, ariſing from the mixture of theſe like ſolutions with the thermal waters of Aken; we muſt here anticipate, and tell the reader, what we ſhall hereafter by experiments prove, that theſe waters contain an earth, of the abſorbent or calcarious kind, a fixed alcali, of the mineral claſs, and ſea ſalt; which, together with the volatile acid and the phlogiſton, with ſome air, inſeparable from water, will be found the conſtituent parts of the bath waters of Aken: For, all the urban and ſuburban baths conſiſt of the ſame ingredients, differing onely in proportions. The different ſolid contents of the waters, the earth and the ſalts, ſeverally, are capable of precipitating all manner of metallic ſolutions in acids. Sea ſalt and it's acid precipitate ſolutions of lead, quickſilver and ſilver in the acid of nitre; the vitriolic acid partly does the ſame. And water ſlightly impregnated with the imflammable principle, as by boiling ſul-

[a] § 293, 60. and the following.

phur or deſtilling hepar ſulphuris, in water; cauſes a milkineſs with a ſolution of corroſive ſublimate. Here then, each may be thought to act it's reſpective part, and in ſome, more than one to concur. A double decompoſition is certainly produced in every mixture; that is, the union of the metal or metallic ſubſtance with it's ſolvent is broken, by the interpoſition of the parts of thoſe bodies in the water, that have ſtronger affinity to either, than theſe to one another; and as the acids, in theſe ſolutions, more ſtrongly attract, abſorb and unite with, the terrene or ſaline parts of the water, than thoſe with the volatile acid of the water; that compoſition, according to our general idea of ſalts, muſt be ſpoiled of it's component parts, or ſome of them. Let us take a more particular view of each apart;

X. *The preceding Phaenomena explaned.*

§ 315. 1. The ſolution of mercury, uſed in 60, 61, 62. partly diſcharges the water of it's volatile parts, in the ebullition raiſed upon mixture; then, gives a fair precipitate of mercury; partly from the mineral alcali, and partly from the ſea ſalt. This anſwers all the purpoſes of ſuch a precipitate. And part of it, that owing to the acid of ſea ſalt, may be ſublimed into a corroſive ſublimate.

§ 316. 2. The ſolution of the cryſtals of mercury in water, N° 63, 64, 65. containing barely enough of the acid to keep the mercury in this ſtate of ſolution, cauſes no perceptible ebullition upon mixture with the waters. And, as few or none of the more volatile parts of the water eſcape; they, particularly the ſulphureous acid, charged with an abſorbent earth [a], as I apprehend, give it this yellow tinge; as I take it's

[a] The vitriolic acid, charged with any calcarious earth, cauſes a yellow precipitation with a ſolution of quickſilver in the nitrous acid.

muddineſs to be derived from the phlogiſton; of which, the laſt, N° 65. gives us ſome proof: For, that water being in a great meaſure ſpoiled of it's phlogiſton and acid, it cauſes a quicker ſeparation of parts, or a decompoſition; but, with much leſs change of color, than either of the preceding. But, the yellowneſs may alſo be produced by the ſalts of the water. § 338. d.

§ 317. 3. The ſolution of corroſive ſublimate, N° 66, 67, 68. is partly precipitated by the volatile parts of the water, in N° 66 and 67, as appears upon mixture with the condenſed vapor[a], partly by the abſorbent earth, combined with the ſalts; one of which, to wit, the alcali, by itſelf, would cauſe a yellow precipitate, had it been leſs diluted. The phlogiſton here ſhews itſelf in the pellicule; for, thoſe on 66, 67, are higher colored than that on 68. Which is preſumed to be owing to that ſubtil principle; from different modifications and combinations of which, all colors, as well as odors, ariſe.

§ 318. 4. The ſolution of lead, N° 69, 70, 71. may be precipitated by the acid, as well as by any of the ſolid contents of the water. All of which concur in 69 and in 70. But, in 71, the earth and ſalts alone are concerned, and of theſe, the alcali chiefly. But, in theſe, we have the cleareſt proof of the exiſtence of the inflammable principle in theſe waters, and of it's extreme volatility and ſubtility. We ſee, the mixture and the conſequent precipitations are moſt colored and obſcure with the neweſt drawn water, and leſs colored and bright in proportion to the diſtance of time from the taking up the water, to it's being totally ſpoiled of it's volatile principles by evaporation: For, in the evaporated water, the clouds and precipitate are completely colorleſs, perfectly white. The like happens to this water, taken up at Aken, and conveyed to London. If care be not taken in the filling and ſtopping the bottles, ſuch as are not quite full here give no more proof of phlo-

[a] § 216.

giſton, by this or any other teſt, than the evaporated waters. But, it is proper to note, that though the bottles, on which this trial was made, were well corked and cemented; they had not been full. They were ſtopped up hot, while the water was in a ſtate of rarefaction; when it cooled, it was more condenſed, and conſequently, occupied a ſmaller ſpace; whence, ſome part of each bottle was neceſſarily empty of any thing, but air; into this, the ſubtil phlogiſton might have eſcaped. Hence, a proper caution for the tranſporting this and all other hot and ſubtil mineral bath waters may be drawn: The bottles ſhould be firſt filled at the ſource, then inſtantly ſtopped and layed upon their ſides. As ſoon as all are cold, they ſhould be ſeverally filled out of ſome one or more of themſelves, then again carefully corked, the neck dried and dipped in barely melted cement, then tied over with ſoft leather or bladder. By this means, all that may be, will be, and none of the volatile parts can be otherwiſe, preſerved.

§ 319. Taking this caution, from theſe obſervations, I ſent to Aken and had ſome of the water bottled and ſecured in this manner, with cement and a bladder. And I had the ſatisfaction to find, and demonſtrate to ſeveral curious and judicious gentlemen of our faculty and others, that by this means, theſe thermal waters were tranſported to London with very little loſs or change, more than that of heat. That, which came in glaſs bottles, was in much higher pefection, than that, which was in ſtone bottles, equally filled and ſtopped; which ſhews the extreme ſubtility of this principle.

§ 320. 5. The ſolution of ſilver comes here in aid of this diſcovery. This ſolution is precipitated by abſorbent earths, by alcaline ſalts, by ſea ſalt and it's acid, as well as by the vitriolic or ſulphureous acid; as ſet forth in our general idea of ſalts. The change of color to a yellow in the clouds and coagulation ſubſequent to dropping, in N° 72, I attribute to the phlo-

phlogiſton; the white precipitate, to the abſorbent earth and the alcaline ſalt; the ſlate or aſh-colored, to the ſea ſalt, which gives, what this is, Luna cornua. The proof of this appears from the following experiments, N° 73, where the colors are ſenſibly diminiſhed, and N° 74. where no color ariſes; except upon the ſubſidence of the two-fold precipitate; which muſt be owing, 1. to the dimunition, and 2. to the total diſſipation, of the phlogiſton.

§ 321. 6 and 7. The ſolutions of copper and iron in the blew and green vitriols are precipitated by the ſolid contents; that is, the terrene and more fixed ſaline parts of the water onely. And that, upon principles before explaned.

§ 322. Now then, that the nature of the volatile parts of theſe thermal waters, ſuch as the phlogiſton and the acid, as well as the ſimple water, in which theſe and the fixed parts are found united or blended, are, as I hope, pretty ſatisfactorily explaned,

§ 323. We now procede to inveſtigate the nature of the ſolid or fixed contents of the water, and the proportions, they bear to the fluid or aqueous parts, as well as to each other.

XI. *Of the ſolid contents of the* WATERS.

§ 324. Theſe fixed parts of the water were ſhewn, by their effects, in the preceding experiments, with various dying ſtuffs, with alcalies and with acids, with ſolutions of ſalts, metals, &c. But, theſe alone are not ſufficient for the ſatisfactory information of the curious and ſtrict enquirer; therefore, it is neceſſary to have recourſe to other means of demonſtration.

§ 325. As the volatile parts of theſe waters are diſſipated, upon ſtanding in the open air, as well as by deſtillation and evaporation; we thus obtain the ſolid or fixed matters diſſolved in the waters, in one com-

mon maſs, or ſeparately, by evaporation and cryſtalliſation.

§ 326. 1. Theſe waters expoſed to the air, ſoon loſe ſome portion of their volatile acid and phlogiſton; and ſhew a pellicule on the ſurface, which is part of the earth of the waters [a]. In proportion, as theſe volatile parts are exhaled, in the open air, by deſtillation, or by evaporation; ſo does the water grow milky and turbid and this pellicule increaſe; till it grows heavier than the water, and then ſubſides or coates the ſides of the containing veſſel. When the water is almoſt exhaled, another kind of pellicule appears; this is pellucid and ſaline. If the evaporation be ſlowly continued, without ſtirring, this pellicule falls in; but will ſoon be ſucceded by a ſecond; the ſecond by a third, and ſo on, till all the humidity be exhaled. Then, the ſaline parts are found in laminae, ſcales or flakes, one above an other; which made ſome idly compare it to the manner of the cryſtalliſation or coaleſcing of the diuretic ſalt of our diſpenſatory, whimſically called by ſome writers, from it's appearance, Terra foliata tartari. Under theſe ſaline concretions, the earth of the waters is found, more firmly adherent than the ſalts. Thus, the ſolid or fixed contents of the water are obtained; and, as nearly as the matter can be aſcertained, in the following proportions, in the different waters.

§ 327. 2. I took four ſmooth ſtone pots, that might hold about a quart each. I labelled them ſeverally, and placed them in a ſand furnace. I took a certain pint bottle, which I weighed and marked. This held ſeventeen ounces and an half of any of the thermal waters. With this bottle, I meaſured the ſeveral waters, I had occaſion to evaporate; and having put one of my meaſures of the different waters into each of the pots, whoſe labels bore the particular name; I proceded to evaporate, with all imaginable care and caution, to a dryneſs. Then, while yet hot, as well as dry,

[a] § 61.

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ſcraped out the fixed contents carefully, and weighed them, as exactly, as the beſt apothecary-ſcales and weights, I could meet, would admit. I repeted theſe experiments often, and ſeldom found them exactly agree. Here, I have ſet down the extreme quantities, the ſmalleſt and greateſt, which theſe waters were found, upon theſe trials, to yield. They are found liable to vary, from innumerable accidents, and do ſo, eſpecially in ſmall quantities. But, from theſe, the medium may be taken. I obtained, of this mixed reſiduum,

From the ſource of the Emperor's bath, the meaſure of $17\frac{1}{2}$ ounces, from $37\frac{1}{2}$ to 40 granes.

From that of the New bath, in like quantity, from $36\frac{1}{2}$ to 40 granes.

From that of the Roſe bath, in like quantity, from 33 to 35 granes.

From the Fountane, in like quantity, from $31\frac{1}{2}$ to 35 granes.

From the Fountane near Bordſcheit, on the eaſt ſide of the ſtream of waſte hot water, in like quantity, from 33 to 36 granes.

§ 328. Finding the other baths depending more or leſs upon one or other of theſe ſources, I did not think it neceſſary or ſatisfactory to give each of them a trial apart: Since, from theſe, thoſe may be judged of. In this judgment, they can not much err, who remember, that the nearer the ſource, the hotter, the brighter or the more pellucid, and the ſtronger im-

pregnated with all their ingredients, are all theſe and ſuch like waters found.

§ 329. Before I had recourſe to this method of evaporation, I ſubmitted to the common manner of performing it at Aken, in iron pots. I judge it proper to inſert the product of this proceſs, as a caution to others.

§ 330. I confeſs, I did not, at firſt view, apprehend, that they had erred, who truſted to the evaporation of ſuch waters in iron, as appeared at firſt trials if not ſtrictly, nearly neuter, and afterwards alcaline. But, experience convinced me of the error. I took then, a large flat, or ſhallow caſt iron pot, placed it over a ſtove with a clear charcoal fire, with ten pound eight ounces of water from the ſource of the Emperor's bath. I proceded to evaporate it ſlowly; it exhibited the like appearances, as the preceding evaporations; both loſſed their fetid ſmell in the firſt boiling heat, threw up a terrene pellicule, grew milky and turbid, let fall ſome earth, which looked, like the pellicule, aſh-colored, while wet, but much whiter, when dry. In the proceſs, this pellicule diſappeared and ſubſided. When ſomewhat more than half was exhaled, an other pellicule, ſeemingly ſaline, took the place of the firſt, and ſoon after fell in, eſpecially in the middle, and ſo was gradually ſucceded by an other; until all the humidity was exhaled. All the dry contents, that could be thus obtained, did not weigh above four drachms and twenty four granes. By which it appears, a conſiderable loſs is ſuſtained in this ſort of evaporation.

§ 331. But, what ſurpriſed me moſt in this proceſs, was what I obſerved from the firſt, though till I had made ſtricter examination, could not account for; the liquor, when evaporated to about half, began to appear colored; which color increaſed, as the humidity decreaſed, to a pale beer-color, till all moiſture was exhaled. Then it appeared white.

§ 332.

§ 332. This color, I found to have ariſen from a ſolution, or rather corroſion, of the iron; which, at firſt view, may ſeem a ſort of paradox; but, will clear up, when what may be collected from the preceding experiments is conſidered; to wit, that though the water upon every experiment appears either nearly neuter, or perfectly alcaline, and conſequently, incapable of diſſolving or corroding this metal in the ordinary way; yet, does it's vapor manifeſtly carry with it an acid. This then, not the bath water in the aggregate ſtate, corrodes a portion of the iron above the ſurface of the evaporating water; which, trickling, or being waſhed in, by ſome of the ſucceding, though inſipid, vapor; gives this color to the evaporated water.

§ 333. Proofs that this was a ſolution of iron are, 1. The color's being deſtroyed by all, eſpecially the mineral, acids. 2. The precipitations, with ſolutions of lead and mercury, are tinged yellow in the upper part, which ariſes from the martial earth precipitated. 3. and laſtly, The water evaporated in clean glaſs or ſtone veſſels never changes it's color from it's firſt growing milkey to the laſt. Hereby, we detect the errors of thoſe, who evaporate theſe, or indeed any other waters, in this manner, and diſcover a mixture of iron in the reſiduum of ſuch an evaporation, and hence we learn, whence it comes.

§ 334. Having thus obtained the mixed maſs of the fixed contents of our waters; it remanes, that we examine it and ſhew of what it conſiſts, and the proportion of each ingredient in the compoſition, reſpectively. It is compoſed of an earth and two kinds of ſalt, the one fixed, alcaline or lixivial, the other neuter; to wit, the mineral alcali and ſea ſalt.

§ 335. What ſeparates from the waters upon ſtanding in the open air; whether that, that flotes on the ſurface, which, from it's ſoft and unctuous feel to the touch, has hitherto been looked upon as oily or bituminous; that, that encruſts the baths, in which it

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lyes long, with a ſtoney concretion; that, that gives them a milky hue and ſubſides firſt in form of a whitiſh magiſtery, and afterwards, becomes a black mud; whatever is ſeparated from them by evaporation or deſtillation, to the abſumption of about half the humidity; and whatever is precipitated from them by the addition of fixed or volatile alcalies, liquid or concrete; are all found, 1. inſoluble in water; conſequently, earth. 2. But, retaining more or leſs of the ſalts of the water, or the ſalts, by which it was precipitated, which are eaſily ſeparated from it by waſhing in deſtilled water. 3. That, which ſeparates upon the bare loſs of the volatile acid of the water, as in the open air, is the fineſt, or in the moſt ſubtil ſtate of diviſion; conſequently feels ſofteſt and ſmootheſt, like fuller's earth, with which the territories of the town and the neighbourhood abound. Hence, it is always found floting on the new drawn baths and other collections of the cooling waters[a]. Next to this, that which is precipitated with diſſolved alcalies is the fineſt, as it alſo is the moſt white. That, which is ſeparated by evaporation or deſtillation, is at firſt light and ſubtil; but, as the operation procedes, it coaleſces and forms ſandy or gritty concretions. 4. All or any of theſe, to about three parts in five, diſſolve in the acid of ſea ſalt, with an ebullition, and blunt it's acidity. And, 5. being long in a ſtrong fire calcined, give much white calx, or pure lime, in all reſpects. By 4 and 5. it appears to be partly a calcarious or abſorbent earth. 6. What does not diſſolve or become lime, is ſelenite. This ſhews the miſtake of ſome great men, who have by ſome means been led to take things upon hear-ſay. BERGER[b], and after him HOFFMAN[c], aſſerts, that the waters of Aken depoſite an ochrous earth; the contrary of which is evinced by theſe experiments, as well as precedent obſervations.

§ 336. We may judge of the proportion, this earth bears to any given quantity of the water, by ſe-

[a] § 61. 165. 336. [b] De Therm. Carolinis. [c] De Acidulis et Thermis. Parts before cited.

parating

parating the ſalts from it, by waſhing with pure deſtilled water, and then drying and weighing it, to determine the loſs.

§ 337. For this purpoſe, I took of the pure reſiduum after evaporation of the thermal waters of Aken, two drachms; poured upon it two ounces of boiling deſtilled water, and agitated them to a perfect ſolution of the thermal ſalts. Mean while, I took a coffin of cloſe filtrating paper, which I weighed and noted: I then decanted the ſolution and paſſed it through the filtrating paper; poured new hot water on the reſiduum, and when the firſt was paſſed, threw this into the ſame paper. I repeted this elutriation or waſhing and this filtration, till I found the water was no longer affected in taſte or effects by the reſiduum. I then ſlowly, carefully and perfectly dried the paper, and found it had increaſed in weight ſix granes and an half; which may certainly be pronounced the ſum total of terrene parts in two drachms of the reſiduum of the firſt evaporation. All the reſt is the ſalt or ſalts of the water, which may be ſeen by cautiouſly evaporating the ſolution to a dryneſs. The reſiduum of theſe waters, like that of moſt others, of a ſimilar nature, is found to have more earth and leſs ſalt in proportion as the waters are quickly or ſlowly evaporated, and according to the nature of the veſſel, in which the operation is performed. This had been done in an iron pot; but, that done more ſlowly, and in ſtone veſſels, gave but five granes of earth, much lighter and whiter, from the ſame proportion. If then a pint of Aken water contains thirty five granes, which is about the medium, of ſolid matter, it is eaſy to ſhew, that not much above an eleventh part of it is earth, of the nature before explaned; the reſt, ſalts of a nature to be hereafter explored.

§ 338. The waſhings of this mixed reſiduum, thus filtrated, gave a clear, colorleſs ley; which, upon evaporation in a flint ſaucer, threw up a ſaline pellicule; which, partly precipitating, was ſucceded by another, and

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ſo on; till it was all reduced to an heap of dry laminae. Then, I broke, mixed and ſtirred them with a little glaſs ſpathula together, till all became a perfect dry powder; by which it loſſed a grane or two of the weight it ſhould have had; for, of this very dry ſalt, I had but one drachm two ſcruples and twelve granes; the reſt being waſted in the operation.

a. This ſalt was very ſoluble, requiring but little more than an equal weight of pure water to diſſolve it. Upon throwing it into deſtilled water, a ſmart ebullition enſues, as upon throwing in dry alcaline ſalts.

b. It cauſes an ebullition with all acids; and with the concentrated or ſtrong acids of nitre and vitriol, yields copious white fumes like ſea ſalt, or rather ſoda.

c. It changes ſirup of violets inſtantly to a bright green. Waſhed with three different portions of water, the laſt, as well as the firſt, produces the ſame effect.

d. It precipitates all the metallic ſolutions; and with that of corroſive ſublimate, forms a fuſcous or orange colored precipitation; and with a ſolution of mercury in acid of nitre, a pale, lemon colored magiſtery ſubſides.

e. It decompoſes ſalt ammoniac, as fixed alcalies do; and, in the reſiduum, uniting with the acid of ſalt, gives true ſea ſalt. If otherwiſe ſuturated with the marine acid, it produces the like effect.

f. Saturated with the nitrous acid, it gives by deſtillation the acid of ſalt, with ſome of the acid of nitre, conſtituting therewith an Aqua Regia.

g. Saturated with the vitriolic acid, by deſtillation, it yields the marine acid and the reſiduum gives pure Glauber's ſalt. If the ſolution or ley of the thermal ſalt be but ſaturated; by evaporation, it yields ſome Glauber's ſalt and ſome ſea ſalt.

h. It cryſtalliſes much in the ſame manner, as ſea ſalt does; but, runs more into the form of the cryſ-

cryſtals of ſoda or kelp; with which, it ſeems to hold great affinity. The preceding experiments prove this: For, ſoda, which conſiſts of ſea ſalt and the mineral alcali, whoſe union is hardly ever to be perfectly broken, ſo far as to ſhew each in it's proper form and proportion apart; produces much the ſame effects with theſe; except the colored precipitations in the mercurial ſolutions, which are not of ſo high a tinge with ſoda, as with this thermal ſalt; which contains more fixed alcali, than the generality of kelp. In this reſpect alſo, ſoda and our thermal ſalt are analogous; that the alcali and marine ſalt are in effect inſeparable in each.

§ 339. Hence then, we ſee, that about a pint, or the quantity aſcertained by the weight of ſeventeen ounces and an half, of theſe thermal waters yields, upon a medium, thirty five granes of ſolid contents, of which an inconſiderable fraction above three granes is an abſorbent or calcarious earth, with about three fiveths, ſelenite; and ſomewhat above thirty one granes of a mixed ſalt, partly fixed and lixivial, the pure mineral alcali, partly muriatic or true ſea ſalt; bearing great analogy to that uſeful ingredient in glaſs, ſope, &c. called ſoda or kelp; and with that correſponding, in it's ſweetening, reſolvent, deterſive, aperitive, deobſtruent, diuretic and lithontriptic or ſtone-breaking qualities.

§ 340. By the preceding experiments and obſervations, I apprehend it is now made evident to every intelligent reader, that theſe celebrated baths conſiſt of ſimple water charged with a volatile, mineral acid, and impregnated with phlogiſton; contrary to the received notions of STAHL[a] and other philoſophic chemiſts; who deny this principle's being ever ſenſibly united with water, in this manner. If it were poſſible to aſcertain the proportion of ſulphur ariſing from any given quantity of this water, the proportions, theſe principles bear, might be demonſtrated; as there

[a] Animadverſ. Exp. & Obſerv.

are

are fiveteen parts of the acid to one of the phlogiſton requiſite to conſtitute the concrete, called ſulphur or brimſtone. But, as the one can not be known, ſo the other can not be ſhewn, with certainty. Theſe make three of the conſtituent parts of Aken baths. The fourth appears to be calcarious earth, with ſelenite, which ſeparates, as the volatile acid eſcapes; the fiveth is the mineral alcali, and the ſixth, ſea ſalt; to which, a large portion of air is always to be added. Theſe are found in different proportions, as before obſerved, in all the baths of the city and ſuburbs of Aken. Upon all theſe trials, it appears, that there is no actual ſolution of ſulphur in theſe waters. Had there been ſulphur ſubſtantially diſſolved in them, as moſt conclude to be the caſe, in this and other waters of this like ſmell; it muſt have appeared upon the addition of acids and other experiments. And as there is no ſuch appearance, the long prevaling notion, of actual ſulphur in all waters with the ſmell of putrid eggs, muſt be but ill founded. Let us next enquire how this extraordinary compoſition may be produced.

X. *Of the heat and cauſes of heat in theſe and other* BATHS.

§ 341. As heat is the great agent, by which this compoſition is produced, as well as ſeveral of it's component parts, the giving a rational idea how this and other Baths become thus heated and impregnated, muſt I judge, be ſatisfactory to all thoſe, that have not had leiſure or opportunity of entering into the curious, but difficult, diſquiſition.

§ 342. As I have hitherto endeavored at as much brevity, as was conſiſtent with perſpicuity, I have purpoſely avoided all direct controverſies; contenting myſelf, and I hope ſatisfying the readers, with laying down truths, without always pointing out where or in what mine opinion coincided with, or differed from, that of others; except in ſome glaring inſtances, not

to be omitted with Juſtice or propriety. To purſue the ſame plan in the ſequel, I judge it proper barely to glance in a general manner at the variety of falſe notions conceived and propagated about the cauſe of heat in baths: For, many of them are too abſurd, too ridiculous, to level a regular argument at them; few or none of them, are of importance or credibility enough to require much time or paper to expoſe them; and to encounter them all formally, would be an endleſs, as well as a trivial, undertaking.

§ 343. The firſt notion of the cauſe of the heat of baths ſeems to have been furniſhed by the places, in which they were firſt diſcovered and are ſince commonly found: Theſe are obſerved to be where ſulphur or bitumen or foſſil coal abounds. Hence, it was concluded, that where ſuch plenty of fewel was diſcovered, and that near a bath, they could not be at a loſs to conceive how theſe combuſtibles may catch fire and burn in caverns in the earth, ſo as to heat the adjoining ſoil, and of courſe, the neighbouring ſprings. This was ſtarted by EMPEDOCLES, as SENECA[a] records. This firſt ſage, in all ſucceding ages, found many followers among philoſophers, phyſicians and poets. Among the chief of the firſt and ſecond claſſes were ARISTOTEL, VITRUVIUS, AGRICOLA, CAESALPINUS, BACCIUS, FALLOPIUS and KIRCHER.

§ 344. This, may poſſibly prove none irrational method of accounting for baths in the vicinity of Volcanos; as about the burning mountanes of Aetna, Veſſuvius, Hecla and the like; whoſe actual fires, by the very apertures of the irruptions, prove, they want none of the air or ventilation ſo neceſſary, that without it, flame or fire can not ſubſiſt. But, how is it to explane the heat of thoſe baths, which are found ſo remote from any irruption of fire or ſmoak from the earth, that nothing like it has ever been known with-

[a] Natur. Quaeſt. lib. iii. c. 24.

in

in hundreds of miles of it? Or, as here in Britain, where we have variety of hot natural baths, without ever having had any other proof of ſubterranean fire or heat of any kind? He muſt be an abſolute ſtranger to the nature of fire, who does not know, that it can no where actually ſubſiſt without a free intercourſe with the air; which, while it ſupplies it with other requiſites, gives vent to it's fumes or ſmoak. An actual fire under, to produce any ſenſible effect above, ground, muſt undoubtedly have flews or funnels, for this purpoſe, which is rarely found to be the caſe any where, except adjoining or near the burning mountanes before mentioned or ſuch others.

§ 345. But, the aſſerters of this notion were at a loſs to make out how their fewel was to take fire at firſt, before they could, even in their heated imaginations, ſet it burning. In this, they ſeem to be but lamely helped out by [a] ſuch as aſſert, that ſubterranean caverns replete with ſulphur, having the waves of the ſea drove by the fury of the winds againſt that combuſtible, may be ſet on fire. Who knows not, that though ſulphur may, by the attrition of two hard bodies, be ſet on fire; yet, even there, it's catching fire may for ever be impeded by keeping it wet with any water? However abſurd this may now appear, it was once the prevaling opinion of philoſophers, as well as poets; and continued ſo, whileſt the multitude gave fiction the ſanction of authority; and this authority thus once eſtabliſhed and promulged took place of unexplored truths.

§ 346. Much of a piece with theſe notions, is that of an immenſe quantity of fire placed by fruitful brains in a great cavern in the center of the earth; thence ſuppoſed to be the cauſe of all ſubterranean heat, of the origine of ſprings, cold as well as hot, and of the production of medicated waters in general. Of this, the revered Father KIRCHER [b] framed many ele-

[a] ALDROVANDUS in muſ. iii. c. 13. [b] Mund. Subterr. T. 1. l. 2. c. 17.

gant

gant phyſical romances, with equal truth perhaps, with any hiſtories, we have of the moon. Yet, he did not want followers, of which Blondel [a], the principal writer on Aken waters, was one. Neither has this fiction been put in a better light by Burnet [b], however he labors the point: For, as deep as men have in all ages, eſpecially in this, delved into the bowels of the earth, no proof, no veſtiges of any thing like this central heat has ever yet been diſcovered. On the contrary, where there is not ſome actual fire or heat from other cauſes generated, all deep, ſubterraneous places are found of an equal temperature, as to heat and cold, in all the different ſeaſons of the year. And yet, theſe two gentlemen, eſpecially the former, have talked as familiarly and confidently of ſuch an heat and the works thereby performed, as if they actually had been eye witneſſes of the fact and it's ſeveral operations.

§ 347. To ſave the trouble of difficult and teadious enquiries, Paracelſus invented a ſhort method of accounting for the heat of baths; as others did for the heat of the blood of man and other animals. This they called innate; abſurdly judging, that the author of nature, from the beginning, created certain waters, as well as certain animal juices, actually hot, as he did ſome of the former, cold. But, it is eaſy to ſee, that if the almighty had thus infixed this character upon them, they could never cool; the contrary of which, is daily diſcovered: For, all theſe ſuppoſed innately heated fluids, as ſoon as drawn from the ſources, or removed from the true cauſes of their heat, are cooled to the temperature of the air, ſoil, or other bodies, with which they come into contact.

§ 348. This conceit ſtood it's ground no longer than men remaned ignorant of experimental philoſophy. As this gained ground, theſe wild fictions va-

[a] Therm. Aquiſgr. et Percet. Elucid. [b] Theory of the Earth:

niſhed, as darkneſs is diſpelled by light. I wiſh it could be ſayed, that an abuſe of this moſt uſeful ſcience did not hurry men into other extremes. But, no ſooner was it obſerved, that certain bodies, being mixed with others, as quick lime with water, certain acids with waters, oils, metals and other mineral bodies, as well as with abſorbent earths and alcaline ſalts; produced heat, and in ſome actual fire; than men, who choſe to account for all the phaenomena in nature, by their miſtaken notions of chemiſtry; judged, and boldly aſſerted, that the heat of thermal waters was occaſioned by ſuch incongruous mixtures, as nature never created in the bowels of the earth.

§ 349. If the mixtures, producing theſe effects, could be demonſtrated any where in nature, the weight of theſe like arguments might be eaſily conceived. If for example, the white terrene matter, which Dr. MEARA [a] hit upon in riding about Bath; which he found at once to heat and to impregnate water, and which he looked upon to be the origine of the heat of theſe waters, could be found there or any where elſe in nature, we might give ſome credit to his notion. But, his ſtructure appeared to have been but poorly founded, and conſequently muſt have ſuddenly fallen, when it was diſcovered, that this ſame igniferous matter was but a child of art, a creature of fire, never yet known in nature, even a piece of lime fallen from ſome builder's cart. This ſuperficial naturaliſt leaped at this proof of the opinion of DEMOCRITUS, which he had embraced. This old ſage looked upon baths to have contracted their heat from ſubterranean lime; which certainly can not be produced there without ſubterranean fire, the notion of which is now juſtly exploded. But, if we ſuppoſe fire, to burn the lime, what need we have recourſe to a ſecundary cauſe for heating the waters?

[a] Epiſtol. ad D. Bryam, de Aq. ſeu Thermis Bathon. cited by BERGER. p. 48.

§ 350.

§ 350. Not much more conſonant to reaſon or truth, are the ſentiments of thoſe, who attribute the heat of baths to certain acid ſpirits or exhalations, which they deduce from vitriol, ſulphur or any thing elſe; and with which, they ſay, though they can not tell how, waters are impregnated in the bowels of the earth; ſo as to render them capable of acting upon ſulphureous and bituminous bodies, upon iron ores, abſorbent earths or alcaline ſalts, and, in the conflict, cauſing efferveſcence and ſolution: In the ſame manner, as in chemiſtry we ſee the ſtrong acid of vitriol with water, which produces heat, as it does that and cauſes a ſolution of filings of iron, alcaline ſalts, &c. or, as BORICHIUS [a] taught and SLARE [b], HOFFMAN [c] and HOMBERG [d] further illuſtrated; it is known that the ſtrong acid of nitre, with eſſential and other oils mixed, will cauſe heat, fumes and actual fire and flame; or as antimony, and it's regulus, biſmuth, tin, &c. mixed with corroſive ſublimate of mercury, or as theſe and various other metallic bodies, with other concentrated mineral acids, excite heat and ſuffer diſſolution.

§ 351. Yet, ſuch are the opinions embraced by M. Rochas, who wrote on mineral waters in the year 1635. by Blondel, before cited, and by Pierce [e], Guidott [f], Oliver [g] and others of our country. Theſe will all appear ſo many romantic amuſements to raiſe the admiration of the readers, rather than to ſatisfy their curioſities, when it is conſidered, that none of theſe acids are ever found in nature; except that of vitriol, and this never in ſo concentrated and liquid a ſtate, as to mix with water or any other fluid with ſuch commotion, as to occaſion heat. This then, is but a groundleſs hypotheſis, and every concluſion, drawn from it, muſt of courſe be falſe. But, ſuppoſ-

[a] Act. Hafn. P. 1. N. 71. [b] Philoſ. Tranſ. for Sept. and Oct. 1694. [c] Obſerv. Phyſ. chym. [d] Mem. de l'acad. roy. des Sciences. [e] Mem. of Bath Waters. [f] De Therm. Britan. [g] Practical Diſſert. on Bath-waters.

ing this to be the real cauſe, how will theſe philoſophers be, from their ſyſtem, able to account for the heat of various baths, whoſe waters are found void of all theſe heterogene mixtures, as ſet forth in Part I. § 511. as alſo in this, § 376.

§ 352. Of all the conjectures relative to the cauſe of heat in baths, that of LEMERY [a], for explaning ſubterranean fires, volcanos, earth quakes and the heat of baths, comes neareſt the truth, and has therefore not onely furniſhed many with arguments for this purpoſe, but has taught ſome to conclude, that the waters were, at the ſame time, heated in this manner, and impregnated with ſulphur [b]. LEMERY's hypotheſis is founded on the method of diſſolving iron, by mixing it in filings with an equal weight of flowers of ſulphur and kneading them together into a ſtiff paſte with water. The reſult of which is this; the maſs, in leſs than an hour, grows firſt warm, then hot; whereupon it cracks, fumes, exhales a ſubtil inflammable vapor, and ſoon after catches actual fire and flame, and continues thus to burn, till all, that is combuſtible, is conſumed, and the iron is corroded into a dark brown calx; which, by further calcination in a reverberatory fire, becomes a brighter brown or red powder, called crocus martis aperiens; Opening ſaffron of iron.

§ 353. This author and his followers might have avoided deceiving themſelves and others, had they but conſidered the conſtituent parts of ſulphur, their affinity and firm connection, and had known the difference between entire ſulphur and that concrete once ſet on fire, together with the difference betwixt iron and it's ores; ſince it is notorious, that the former never parts with it's acid, which makes fiveteen parts in ſixteen of it's compoſition, by any means, till it's inflammable parts, which, make but one ſixteenth, are deſtroyed by fire; except in ſolutions with alca-

[a] Cours de Chimie. [b] Doctor Cheyne.

lies;

lies; from whence the phlogiſton is apt to fly off, leaving the acid and the alcali united. As to the later, to wit, iron, it is well known to be ſoluble in all, even the ſlighteſt, acids; that reduced to filings and mixed with any of them, even with rain water or dew, it will be corroded and heated. It is then eaſy to conceive how the acid in the ſulphur, with the help of the water, attacks and heats the iron in this form; how that heat diſſipates or by burning conſumes the inflammable part; whence, a more effectual ſolution or corroſion of the iron is produced, as the ſulphur is thus effectually decompoſed.

§ 354. But, that this can not be analogous to the method, by which baths are produced in nature, and though it had, that waters can not thus be impregnated with ſulphur, according to the notion of theſe gentlemen, and their followers, muſt be obvious from the following conſiderations;

§ 355. 1. In the firſt place, iron is not, in the metallic form, produced by nature. And, though it were, it is not to be imagined, that it can be produced thus mixed with ſulphur. Nor is it to be conceived how ſuch a mixture as this ſhould be made in the bowels of the earth, or being there made, how it ſhould be ſupplied regularly for many centuries, ſo as to keep up an equal and uniform heat in baths.

§ 356. 2. If it be imagined, that ſulphur may be thus mixed with the iron ore or mine, and being mixed would thus be diſſolved by the acid of ſulphur, it will involve the favorers of ſuch opinions in greater perplexities and abſurdities: For, all the chemiſts and naturaliſts, that have examined theſe matters, are agreed, that though iron, when once by art extracted from its ores, be as ſoluble as above mentioned; yet, the iron ores, even thoſe, that are ſo rich as to be ſtrongly attracted by the magnet, are not found ſoluble in any, not even in the ſharpeſt, acids.

§ 357. 3. But, let us indulge theſe philoſophers a while, in ſuppoſing, that actual iron, even reduced

for their purpoſe to filings, and knead into a paſte with ſulphur and water, is found in the bowels of the earth; or, that the ores of iron, like the pure metal, may be wrought upon by brimſtone, in the manner above recited; let us hear how they imagine the reſiduum of the burned compoſition will give a ſulphureous water?—The mixture of iron and ſulphur, unleſs ſet on fire, ſuffers but little change; the ſulphur is not then ſoluble in water; nor the iron, more than it was without the brimſtone. It can not then give a water charged with ſulphur. But, the mixture being once ſet on fire, is not eaſily extinguiſhed, till the ſulphur is decompoſed, it's phlogiſton conſumed by fire, and it's acid united to the iron. With what then will this maſs be able to impregnate water? With a ſolution of iron, martial vitriol; and it is not poſſible, it ſhould charge it with any thing elſe. Thus, theſe erroneous notions need onely to be expoſed, to be corrected.

§ 358. Having then, with all poſſible brevity, layed open the fallacy of theſe opinions; I now procede to explane the juſt cauſe of heat in Baths. And this, I apprehend to be a burning or ignited Pyrite.

§ 359. Several have curſorily touched upon this cauſe; but none before BERGER, within my knowledge, has given it the requiſite illuſtration; though few, if any of the naturaliſts, ancient or modern, can be found ignorant of the plenty, in which this mineral has been, and now is, almoſt every where diſcovered, or of it's principal qualities or effects. The firſt, that I find, who aſſerted the Pyrite to be one of the cauſes of the heat of baths, is our great LISTER[a]; but, though he well knew the properties of that mineral; yet, in this operation, he confounds it with the limeſtone; without which, in a condition inconceivable to me; to wit, vegetating, he imagines the pyrite inſufficient to ſuccede. But, let us firſt determine what is

[a] De font. medicatis Angliae.

to

to be underſtood by the word Pyrite, and then ſhew how the effects, here apprehended, may thereby be produced.

§ 360. This mineral was known to the Greeks[a], by the name of λίθος πυρίτης, lythos pyrites; and to the Latins, by a name borrowed from thoſe; to wit, Lapis pyrites or pyrita. The Arabians knew it by the appellations, Hager al, Alruſenai and Marchaſita; which later, with ſome corruption is retained by ſome writers in the modern languages. It is likewiſe by ſome called, Igniarius, Ignifer and Lapis Lucis; from the greek idiom, which ſignifies fire-ſtone; either from this mineral's producing fire, when expoſed to the air and wet, or it's aptitude to give fire by friction or percuſſion, with itſelf on any equally hard body.

§ 361. Great pains have been taken to reduce theſe minerals to certain diſtinguiſhing claſſes; but, to little purpoſe, from the infinite diverſity, which may be looked upon as ſo many ſportings of nature, in the formation of theſe productions. It is impoſſible to determine the ſhape or ſize, the color or conſiſtency, nor even to aſcertain the place of growth of the Pyrite. It is found oftenеſt tending to a round, conglobate or conglomerate form; that is, when it is made of one, or of more ſpherical or ſpheroid lumps united; but, it is often found made up of broken ſquare and other irregular figures; to ſay nothing of the various ſhell fiſhes and other bodies, we find mineraliſed with pyrite. It's color is ſometimes uniform and ſometimes compoſed of all the colors in different proportions. We find Pyrites, white, grey, aſh-colored, ſilver-colored, gold-colored, copper-colored, braſs-colored, lead-colored, iron-colored, and of different ſhades and mixtures of green, blew, red and black; but, always vened with ſome metallic appearance; whence, they were by AVICENNE attempted to be claſſed, from their reſemblances of theſe

[a] DIOSCORID. lib. v. c. 96. GALEN. de ſimp. medicam. facultat. lib. ix.

metals, into gold, ſilver, copper and iron pyrites. Which proves, he knew more of this matter, than either the Greeks or Latins, who mention but that, which contains copper onely. The conſiſtency of this mineral is likewiſe various. It is found often porous, ſpongy and hollow; but moſtly ſo compact, ſolid and ponderous, as with this and it's metallic ſplendor, to make the ignorant often miſtake it for a rich mine or an actual metal. It's place of growth is as uncertain: It is often found in immenſe great venes or huge maſſes; of which alone, whole mountains are compoſed; and there is hardly any mine, of what kind ſoever, free from pyrite. It is found in marſhy ground and in clay; and often in dry, rocky and ſandy hills. It is moſtly compoſed of iron and ſulphur; but it is often impregnated with various other metals and metallics, and with cobalt or arſenic, with antimony, biſmuth, &c. and with the alum mineral; and never free from earthy or ſtoney matter of one kind or other. It is found in plenty in and about coal mines; where nothing is more injurious to the miners; ſince from this, in theſe, as well as other, mines, thoſe deſtructive exhalations, called Damps, thoſe of the inflammable kind eſpecially, generally, if not ſolely, procede. The particular kind of pyrites known about Aken, I have pointed out before, § 73. 2.

§ 362. Having given this general idea of the Pyrite, it remanes, that we ſhew in what manner it is capable of producing heat under, or above, ground; in which, it will not be difficult to make this mineral appear, not onely the cauſe of all ſubterranean heat and fire, with all their conſequences, whether dreadful or deſireable; but even of the meteoric or atmoſpheric Lights, corruſcations and fires.

§ 363. The fiery quality of the pyrite ſeems to have been in part known in the earlieſt ages of natural hiſtory. DIOSCORIDES[a] makes the choice of the pyrite conſiſt in a gold color and readily ſtriking fire. And PLINY[b] tells us it derives it's name from it's being

[a] Place cited. [b] Hiſt. nat. l. xxxvi. c. 19. l. xxxvii. c. 11.

full

full of fire. And again ſpeaks of an hard black ſtone, which burns the hands upon preſſing it; by which, it muſt be preſumed, he meaned a pyrite; as St. Auguſtine [a] muſt have done, where he ſpeaks of a Perſian ſtone, which held and cloſely preſſed in the hand burns it. And [b] St. Iſidore gives the ſame qualities with PLINY.

§ 364. After this, the well known experiments of extracting ſulphur, vitriol and alum from the pyrite, will ſerve to illuſtrate our proofs.

§ 365. It has been obſerved, that the pyrite in general conſiſts of iron and ſulphur. Hence, it is found ſo extremely combuſtible, as not onely to give fire upon percuſſion or friction with hard bodies; but from humidity, with air, to grow hot and continue ſo for a long time; or if it be very replete with ſulphur, to catch actual fire and burn with force proportioned to the quantity of fewel and the circumſtances of the place wherein it is ſet on fire. This is well known to the workers in alum and vitriol, all the world over, as well as here in Britain: Theſe artleſs operators do but expoſe this mineral to the air and rains, in heaps, upon a pavement ſo conſtructed, as to direct the waſhings into proper receptacles. In theſe heaps, they are found to heat, ſometimes to take fire and moulder into duſt; which by elixiviation gives the ſalts required; the inflammable principle being diſſipated or conſumed in the operation. Where there is more ſulphur in the pyrite, than is neceſſary for the production of vitriol, and not enough to make it worth the extracting, they pile up this mineral in great heaps, like brick-kilns. There, it will grow hot in time, catch fire and burn, a long time; but, to expedite it's conſumption, they ſometimes, with fewel, heat the lower part of the heap; which is ſo communicated to the reſt, as to make a volcano, which holds often for weeks, even months, on fire. Where the ſulphur is found ſo abundant in the pyrite, as to

[a] De civit. Dei. c. v. [b] Originum, Lib. 16. c. 4.

make

make it worth the labor, it is extracted by liquefaction, or a kind of deſtillation, and ſometimes by ſublimation. After which extraction, the reſiduum, containing chiefly the terrene and metallic parts of the pyrite, with ſome portion of the acid of the ſulphur, decompoſed in the operation, is expoſed as the former to the open air; where it acquires new heat, which it holds, till all the remaning ſulphur is conſumed and all the iron or the aluminous earth diſſolved in it's acid; whence martial vitriol, common green copperoſe or alum is produced. Thus, the pyrite is analyſed. By which it appears to be compoſed of ſulphur, a metallic earth, chiefly martial, ſometimes with a limo-cretaceous earth, which yields alum, and always with more or leſs ſtone, ſand or common earth united. Hence, it may well be looked upon as an iron ore; that is, iron not barely mixed, but mineraliſed, with ſulphur.

§ 366. If then it be found, that the pyrite is capable of thus catching and holding fire ſpontaneouſly, above ground; we need but give it the requiſites, where it is naturally found, under ground, and we are to look for the like effects; particularly, a ſlower conſumption of the materials, with conſequently a longer duration and greater equality and uniformity of heat.

§ 367. The pyrite is known to be the miners bane, whereſoever it abounds. Wherever it is by any means heated, it exhales a ſubtil, rare acid vapor, that renders the air incapable of miniſtring it's office ſo neceſſary in ſuſtaining life or flame. This is ſometimes ſo charged with phlogiſton, as to be extremely inflammable and to burn with inextinguiſhable fury and horrible exploſion, if in any confined place, as pits or caverns; or if above ground, to give a conſtant lucid flame, while it can be ſupplied with matter. The ingenious engineer of our White-haven coal-mines has converted this moſt noxious inflammable vapor to a very uſeful purpoſe: For, giving it vent from the pits by proper funnels, and ſetting it on fire at it's exit on the outſide; it continues there inceſſantly burning night

night and day. And thus, while it's extending itſelf within, to the deſtruction of the mine and the miners, is prevented; it is, by this means, conſumed without, and made to enlighten the harbor for the uſe of our navigation; for which it proves a moſt effectual light-houſe.

§ 368. It has before been obſerved, that the pyrite abounds univerſally. We can enter but a ſmall depth into the bowels of the earth in any country, whoſe natural hiſtory we know, without meeting more or leſs of this mineral; that particularly, which contains that moſt valuable of metals, iron; which, from it's great utility to his creatures, the wiſe author of nature has providentially moſt plentifully diſpenſed throughout his terreſtrial creations. Of this, we find, in many places, ſolitary glebes, in moſt quarries and ſand pits. Foſſil ſhells, in many parts of our iſlands, are found mineraliſed with pyrite. Thus, we find immenſe quantities of Cornua ammonis, called Snake-ſtones by our ruſtics, together with various other ſhell-fiſhes, in the iſle of Wighte; in other places, the Echinus, or ſea-urchin or hedge-hog; and kinds of crabs are found thus mineraliſed; as in the iſland of Sheppey. And in the ſand-pits about Woolwych, there are ſeveral ſmall bivalve ſhells of different kinds found entire and fair, withoutſide; but, within, filled with compact and ſhining pyrite.

§ 369. All our mines contain more or leſs pyrite, in or about them. Happily, they have not yet burſt out into actual fire; unleſs in ſome odd parcels of coals after being raiſed out of the pits; which have ſometimes been found ſet on fire, by the abundance of pyrite in them. All the mines, we know of in Europe, contain more or leſs of the pyrite; but, in many, they are ſo abundant, as to prevent their being wrought with ſafety. And the dreadful conflagrations of Hecla, Ætna, Veſſuvius, &c. with all their conſequences, are demonſtrably occaſioned by the ignition and combuſtion of pyrites.

§ 370.

§ 370. All the mines, of which we have any account, in which little or no pyrite is found, however deep they may be, are always found, in hot, as well as cold ſeaſons and climates, of a very conſtant, equal temperature. And all the deep mines, that are found remarkably hot in any ſeaſon or climate, are obſerved to abound with pyrite, whence alone they derive their heat.

§ 371. The extraordinary heat of mines was obſerved by GALEN in thoſe of the iſland of Cyprus. There, large quantities of vitriol were, then and in ſucceding ages, made; which is moſt evident proof of the heat, as well as the vitriol's, being produced by pyrites.

§ 372. In our days, as well as in earlier ages, many mines differently heated, from tollerable to intollerable, have been diſcovered in many parts of Bohemia and Germany. All the curious, that have viſited theſe mines, find them to abound in pyrite; which ſhew themſelves in ſome places, where newly ſtripped of their covering, in ſplendor emulating pure burniſhed metal; in others, catching heat and mouldering; in ſome, covered over with a ſaline efflorescence, evidently vitriolic; in others, where there is moiſture to diſſolve it, trickling along the roofs or walls of the vaults, and there forming great variety of irregular, ſporting figures.

§ 373. Theſe truths are atteſted by AGRICOLA[a], KIRCHER[b], LOBNEISIUS[c], BERGER[d], HOFFMAN[e], and numberleſs other naturaliſts of all ages. There is alſo a mine in the territories of the prince of Leige, called Praion, near Chaud-fontaine, which yields an immenſe quantity of martial pyrite, rich in ſulphur, intermixed with glebes of galaena or lead ore, containng ſilver enough to make it worth the ſeparating. Here, are very conſiderable works, for extracting the

[a] De Re metallica. [b] Mund. ſubterr. [c] De Rebus metallic. [d] De Therm. Carolin. [e] Obſ. phyſ. chym.

ſul-

ſulphur, and making the vitriol, as before deſcribed; as likewiſe for roaſting and fluxing the lead or ſilver ore. But, they are not able to work in the mines in the ſummer ſeaſon, for the extraordinary heat, then occaſioned there. The miners informed me, they always found the mine very hot; but, more eſpecially in the ſummer months, when the ſhafts were filled with ſuch a ſubtil hot vapor, as rendered them quite intollerable, till the next winter. Theſe mines can not be very deep; as I obſerved them to be drained by lifting pumps, wrought with wheels turned by water. Hence, it is eaſy to account for their being ſo ſenſibly affected by changes in the temperature of the air. The warm ſpring, called Chaud-fontaine, much frequented by the people of the principality and neighbourhood of Leige, may reaſonably be ſuppoſed to derive it's heat from theſe mines, whoſe opening is not three miles diſtant from the ſpring; though the mineral vene may lye much nearer in the boſom of the ſurrounding mountanes.

§ 374. But, the ingenious BERGER gives among many others, a curious and convincing proof of the pyrite's being the true cauſe of ſubterranean fire, in a relation of ſuch a fire, within his own knowledge and obſervation. He tells us of ſome mines in Miſnia, near Suarceberg; in which, a pyrite was found, ſo rich in ſulphur, that many hundreds a week of pure brimſtone might be extracted. Theſe mines, he obſerves, by degrees, grew extremely hot; by the extraordinary increaſe of heat, the ſulphur was at length ſo far diſſipated or conſumed, that the mine yielded more vitriol, than ſulphur. In proceſs of time, the heat increaſed ſo far, as to make the mines intollerable to the miners; and at laſt, the timber, that ſupported their ſhafts and vaults, being deſtroyed by the fire, the earth fell in and partly filled the pits; ſo that they became totally deſerted. Four years after, our very ſagacious author found them in this condition, diſcharging an hot ſulphureous and vitriolic exhalation. And he afterwards

terwards learned, that an other neighbouring mine, into which, he had, not above two years before, deſcended; was in like manner layed waſte by the heating of the pyrites.

§ 375. Were there none other inſtance to be offered, this alone ſhould ſuffice to explane the origine and cauſe of ſubterranean fires, heat of Baths, &c. There now remanes no room to doubt, that the volcanos, in Iceland, Italy, Sicily, and elſe where, take riſe and are ſupported from the ſame cauſe; ſince they give ſulphureous vapors, actual ſulphur, and metallic recrements in all reſpects reſembling the products of the pyrite. Hence, the cauſes of earth quakes are undoubtedly to be deduced: Heat rarefies air and water, and with them, when confined, cauſes incoercible exploſions. And it is eaſy to conceive how collections of exhalations from burning pyrites ſhould fill the air with thoſe ſubtil combuſtible vapors and meteors, which cauſe lightening, thunder and other kinds of fires, as well as with mineral particles, ſuch as ſhould give the iron ſhowers, before mentioned from GILBERT on the Magnete. The former notion is countenanced by PLINY [a]; who obſerves, that thunder and lightening give not onely the ſame ſmell, but alſo the ſame light with burning ſulphur. AGRICOLA [b] ſeems to be of the ſame opinion; when he obſerves, that all the kinds of native vitriol, which are produced from the pyrite, give the ſame ſmell with thunder, but moſt of all that, called Sory. Theſe notions may receive new illuſtrations, if what BERGER aſſerts be certain; that the exhalations from pyrites, which cauſe corruſcations and crackling fire, being collected, depoſite an ochrous earth, which being calcined is attracted by the load-ſtone. Theſe ferrugineous particles give greater force as well as brighter luſtre to the flame of ſulphur; as may be ſeen in fuſing this metal, in thoſe fire works,

[a] Nat. Hiſt. l. xxxv. c. 15. [b] De Nat. foſſil. l. iii. c. 16.

in

in which iron filings make a part of the compoſition; or by blowing them through the flame of a candle.

§ 376. This much to be honored author, with great probability, apprehends the pyrite to be one of the principal cauſes of thoſe currents of air, called wind; eſpecially thoſe periodical ones, known by the name of the Trade winds. If theſe be owing to fire, as ſeems generally agreed, a better foundation for that can hardly be found than this mineral. But, more of this would be but foregne to our preſent purpoſe; which is onely to ſhew, that the pyrite is capable of contracting and retaining heat and actual fire a long time above, and ſtill longer under, ground; whence, it is not difficult to conceive, without the help of hypotheſes and fiction, how waters are heated or otherwiſe impregnated by the means of the pyrite. Nor is it neceſſary to have recourſe with LISTER to the vegetating lime-ſtone: For, ſince we find, the pyrite alone can contract heat and fire; we can judge how it communicates theſe to all bodies, ſolid or fluid, within it's reach. Does the heated pyrite emit a ſubtil, inflammable, volatile, acid exhalation? May not waters, paſſing over ſuch pyrites, contract heat and be impregnated with this vapor? Might not ſuch a water be delivered thus from a ſpring upon the ſurface of the earth? Or may it not be qualified, by this impregnation, to produce other compoſitions; ſuch as ſolutions of abſorbent earths, and combinations of different neuter ſalts? Or, if a ſpring ſhould in it's courſe actually waſh a part of the ignited pyrite; muſt it not then be charged with whatſoever the operation of the fire had now rendered ſoluble in water? Would not ſuch a ſpring be vitriolic? Muſt not waters thus impregnated be hot at the inſtant of ſuch impregnation? And may they not be hot or cold in any degree, at the time of their ſhewing themſelves on the ſurface of the earth, in proportion to their nearneſs to, or remoteneſs from, the ſource of heat? Are not all waters, that are found endued with a volatile mineral

ſpirit,

ſpirit, whether cold or hot, ſaline or chalybeate, impregnated in this manner in the earth? And may not a ſpring paſs through a bed of rocks heated by neighbouring pyrites, without ſuffering any impregnation or other change, but heat? — Theſe are not hard to be conceived. And PLINY tells us, that we are not to look upon all baths as medicated waters [a].

§ 377. To this operation of the pyrite, it can be none objection, that pyrites are often found quite cold and unaltered in the earth. This depends upon various circumſtances. The texture and nature of ſome is ſuch, as not readily to catch fire from the action of the air and moiſture; two material requiſites for their contracting heat and conſuming. All pyrites kept from contact with theſe, may for ages remane in their native places unaltered. But moſt, upon contact with theſe or by added fire, are decompoſed as above, and yield the ſubtil exhalations mentioned; leaving the more heavy parts to be converted to vitriol, bole, ochre or umber.

§ 378. From theſe conſiderations, I can ſee no room left to doubt the waters of Aken, or indeed of any other bath, deriving their heat, as well as their volatile parts, from an heated pyrite; even though I want one of the proofs of it, conceived by that eminent philoſopher and phyſician, BERGER: For, he every where aſſerts, that theſe, as well as all other known baths, depoſite a martial ochre, a product of the pyrite in their courſes; the reverſe of which is the truth here; as has been before obſerved [b].

§ 379. To the heated pyrite then, I aſcribe the heat of Aken water: Every cellar or pit, dug in the town or it's territories, and in the whole country round it, yields pyrite, to my knowledge. To the exhalations ariſing from this mineral heated, I attribute the

[a] Nec vero omnes quae ſint calidae medicatas eſſe credendum, ſicut in Egeſta Siciliae, Lariſſa, Troade, Magneſia, Melo, Lipara. Nat. Hiſt. l. xxxi. c. vi. [b] § 166, 335.

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volatile principles, the phlogiſton, and the acid already demonſtrated, in the waters. To the later, the ſolution of earth, of which no water is free, muſt be owing. It then onely remanes, that we give ſome account of the origine of the ſalts, muriatic and alcaline, found in theſe baths.

§ 380. In our general idea of ſalts, theſe have been already ſpoken to. Here, it may be ſatisfactory to give ſome account of their origine in theſe waters. Upon conſidering of what theſe two ſalts conſiſt, we may eaſily account for their being found in theſe waters, in which all the ingredients of their compoſitions reſpectively are evidently found. Nor will it be wondered, that theſe two ſalts are ſo intimately mixed, as to be in a manner inſeparable; when we conſider the alcaline is the baſis of the marine ſalt, as that being ſaturated with the acid of this, can not fail of producing the common ſalt. But, this later is not found in the waters alone; it is diſcovered in a ſaline efflorescence upon the walls of the old baths, thoſe of Keiſer's badt particularly. This was obſerved by BLONDEL [a], but confuſedly deſcribed, under the name of Flos ſalinus; becauſe little, if at all, known to this phyſician. Nor did it eſcape the obſervation of the ingenious Doctor LE SOINNE, in his curious, but too conciſe, diſſertation on the waters of Aken [b]. The former gave it juſtly the appearance of mural or crude nitre; the other does not remove it from this claſs; but ſays, the like is to be found in all damp vaults; by which he hints at it's being the ſame. He, indeed, juſtly obſerves it to be a neuter ſalt; but, does not hint at what kind. I own, at firſt ſight, I took it to be mural nitre, crude ſalt pitre or nitrum calcarium; not that of LISTER, but the crude or immature, that wants an alcaline baſis to complete it. But, upon examination, I can diſcover nothing in it, more than pure ſea ſalt: For, 1.

[a] Book cited, p. 39, 77. [b] Diſſertatio medica in augural. de Therm. Aquiſgran. Lugd. Bat. 1738.

purified by ſolution, filtration and evaporation, it gives cryſtals of a cubical kind, which, 2. keep a dry form; this it alſo does, when evaporated to a dryneſs, which the mural nitre does not. 3. This mural ſalt, thrown on the fire, firſt crepitates; then fuſes; 4. added to the acid of nitre, it mixes without commotion, and makes Aqua Regia; 5. with acid of vitriol, it effervesces, and yields ſubtil, white, acid fumes; 6. the reſiduum, after the expulſion of theſe fumes, gives Glauber's ſalt. Whence, I muſt look upon it to be pure ſea ſalt.

§ 381. But, whether this ſalt deduces it's origine immediately from the bath waters, or from the ſand, which I look upon to be ſea ſand, in the mortar, I can not preſume to determine, without ſeeing it, as Doctor LE SOINNE ſeems to have done, remote from the baths; which never occurred to me during my ſhort reſidence and reſearches at Aken.

§ 382. From this kind of ſalt, it has been before obſerved, the ſalt of the waters is not free. And it is demonſtrable, that this mixed ſalt of Aken baths bears clear analogy to the nitre of the antients, or is rather to be looked upon as identically the ſame thing; whence, theſe waters may juſtly be called, nitrous; but, not in the common acceptation, in which, the modern nitre or ſalt peter is now underſtood.

§ 383. The truth of theſe poſitions will appear by comparing the beſt accounts we have of the nitre of the antients, with what has been ſhewn of the nature of theſe ſalts; by which, it will be found eaſy to demonſtrate in what they agree, but hard to ſhew in what they differ.

§ 384. What the antients knew by the name of Nitrum or Litrum, and alſo that of Natron or Natrum, was found in various parts of the eaſt; as in Aſia and Africa, in Armenia and Macedonia; but, chiefly in Egypt; from a province of which, Nitria, it is ſayed to have derived it's name.

§ 385.

385. This, they diſtinguiſhed into native and factitious: The firſt was either dug out of the earth of various colors, according to the nature of the ſoil; the ſecond was found, 1. like ſtalactites or droppings from the vaults or along the walls of caves and caverns, and was called, Aphronitron, by the Greeks, and Spuma or Flos nitri, by the Latins, the Froth of flower of nitre, from it's remarkable ſpongineſs and levity; or 2. like a ſaline efflorescence or hoar froſt on the ſurface of the earth, when it obtained the name of Halmyrax or Halmirhaga; as if one ſhould ſay, the muriatic ſalt of the earth. The ſecond was extracted from waters, that contained it, or by elixiviation of nitrous earths with rain or any other ſimple water. From the water of the nile's being uſed for this purpoſe, it was imagined, that that river was nitrous; but this miſtake appears from the words of the hiſtorian [a], who tells us, that when rains fall, they have leſs recourſe to the river water. Which ſhews, the nitre to be in the earth, not in the water. Whence, it is probable, the fertility of Egypt, generally derived from the overflowings of the nile, may rather be owing to the waſhing away the redundance of this ſalt, or changing it's nature, than to the adding new to the earth.

§ 386. The uſes and virtues aſcribed to all the ſalts, known by theſe different names to the antients, or by them thus prepared, clearly ſhew the analogy betwixt theſe and the ſalts of Aken water, as well as thoſe of moſt of the hot baths of Italy, Germany and France; to which, thoſe of our Baths in Britain bear no relation; notwithſtanding the ingenious BERGER [b] agrees with Spengler and Guidott in acknowledging them to be nitrous.

§ 387. Whoever looks into the writings of the antients on the ſubject of nitre, ſuch as DIOSCORIDES,

[a] Pliny. [b] Book cited, p. 42.

THEOPHRASTUS, GALEN, PLINY and others, as well as the HOLY SCRIPTURES [a], where mention is made of this ſalt, will find, they all agree with ſome of our beſt modern writers, as Agricola in particular; as well as with the moſt curious naturaliſts, who, of later date, have viſited the regions, where this nitre is produced; ſuch as BELLONIUS, and LUCAS and TOURNEFORT, in their voyages to the Levant.

§ 388. 1. All agree with AGRICOLA in aſcribing to the nitre of the antients a ſaline and ſubacrid taſte, with ſome bitterneſs. The ſame may be ſayed of that of the waters of Aken.

§ 389. 2. All the antients are, with ſome of our moderns, agreed in deeming nitre a kind of marine ſalt, or in looking upon both to be much of the ſame nature and derived from nearly the ſame origine. See PLATO, in Timeao, vel de Natura, p. 537. PLINY, Hiſtor. nat. l. xxxi. c. 10. MATHIOLUS, in DIOSCORID. l. v. cap. 29. AGRICOLA, de natura foſſilium l. iii. p. 206. BRASAVOLUS, in examine ſalium, p. 488. All they ſay, upon this head, may, with equal propriety, be ſayed of the ſalts of Aken water.

§390. 3. The medicinal virtues attributed by DIOSCORIDES, GALEN and PLINY to their nitre; ſuch as being hot, ſharp, acrid, reſolvent, deterſive, deobſtruent, &c. though in no ſenſe applicable to our modern nitre or ſaltpeter, exactly correſpond with thoſe of the ſalts of Aken waters.

§ 391. 4. PLINY [b] and VITRUVIUS [c] call the waters of Cutilia, in Italy, nitrous. The one ſays, they are fit for drinking and purging or for bathing and cleanſing. The other obſerves, that theſe, as well as the waters of Pinna Veſtina, and ſome others of the ſame nature, are nitrous, purge, open and cleanſe the firſt paſſages, and thereby reſolve ſtrumous Tumors. The ſame proves preciſely true of thoſe of Aken alſo.

[a] Jerem. ii. and 22. Proverbs xxv. and 20. [b] Nat. hiſt. l. xxxi. c. 12. [c] De Archit. l. viii. c. 3.

§ 392.

§ 392. 5. The nitre of the antients or their nitrous waters were uſed to preſerve the color of their coleworts and other eſculent herbs in boiling. This PLINY [a] mentions and MARTIAL [b] humorouſly records; where he gives it as a precept, that ſuch greens ſhould be boiled in nitrous water, leſt by their bad color, they ſhould diſguſt. His more elegant expreſſion well deſerves a place;

Ne tibi pallentes moveant faſtidia caules,
Nitrata viridis braſſica fiat aqua.

This caution is well known and obſerved at Aken; whoſe waters are found to anſwer theſe purpoſes, equally well with any other.

§ 393. 6. Laſtly the nitre of the antients was found to bubble in fuſion, not unlike alum, to grow more ſharp and acrid by calcination; to make a ley of a reſolving, cleanſing and abſterſive quality, like our modern ſope leys; whence, it was uſed in baths and for all the purpoſes of waſhing their veſtments, utenſils, &c. It ſerved to make glaſs, and was obſerved to cauſe an ebullition with acids. All which ſhew it to be quite different from our modern compoſition ſaltpeter, which we call, nitre, and too often confound with the nitre of antients, to whom ours was totally unknown. But, in all theſe qualities, the ſalts of Aken water and this true nitre moſt perfectly agree.

[a] L. xix. c. 10. [b] Epigram.

XIII. *Of the medicinal Virtues and Uſes of the* THERMAL WATERS *of* AKEN *in general.*

From the moſt perfect Eſteem and profound
Reſpect
To the complete GENTLEMAN
The moſt accompliſhed PHYSICIAN;
And with due Deference
To exquiſite JUDGEMENT;
Humbly preſented
To
ROBERT TAYLOR, M. D.
Fellow of the ROYAL COLLEGE of PHYSICIANS
of LONDON, and of the ROYAL SOCIETY;
And one of
His MAJESTY's PHYSICIANS.

§ 394. WHOEVER would make a fair eſtimate of the virtues of any medicated water, ſhould firſt remember the qualities of ſimple water, as before layed down, and to theſe add thoſe of the ſeveral ingredients, that enter the compoſition. The water then of Aken Baths appears from the preceding experiments and obſervations to contain, 1. a volatile mineral ſpirit, with much air; both of which are continually flying off from the water, as faſt as it ſprings;

ſprings; as is manifeſt from the ſparkling and air bubbles, that attend it at it's ſource, and it's growing ſomewhat milky and turbid as theſe eſcape; 2. the inflammable principle, which is not leſs volatile than theſe; 3. A ſmall portion of abſorbent or calcarious earth, with ſome ſelenite; and 4. A ſalt, perfectly correſponding in properties and virtues, with the nitre of the antients.

§ 395. Whileſt the volatile principles, particularly the ſubtil acid, remane in the water, it is in a neuter ſtate, by the acids retaining the earth and alcaline ſalt diſſolved, and being, as it were, therewith ſaturated. This I conſider, as the natural ſtate of the water, quite different from that, in which it is found upon the exhalation of this acid or it's propulſion by the addition of heat or any groſſer acid. In the firſt ſtate, it is to be found onely at it's ſource; in the ſecond, when altered by the addition of foregne acids, or as it is found upon ſtanding expoſed to the air, as in the baths, &c.

§ 396. When it is by exhalation robbed of all that is volatile, it is equal to any of the nitrous waters of the antients, and will be found to poſſeſs all the virtues to thoſe, with juſtice or truth, aſcribed. But, in the natural ſtate, this is in many reſpects different, and proves a far more powerful medicine in general. In this caſe, it may be looked upon, as a ſulphureo-nitrous, in the other, as a merely nitrous water. But, let me not be miſapprehended, when I mention it as a ſulphureous water: It is true, it yields every proof of containing ſulphur, that has been ever known in any water, and more than have been juſtly made out in any of the waters, of which I have made trials or received any accounts from others: It's vapor yields actual ſulphur; yet, ſtrictly ſpeaking, it does not contain ſulphur ſubſtantially diſſolved in it; it is but impregnated with the principles of ſulphur, which ſeparating from the water, and uniting, form brimſtone; not charged with an actual ſolution of ſul-

phur, as has been generally imagined. The former is demonſtrated by the preceding experiments; and had it been an actual ſolution of ſulphur, it muſt have been in ſome meaſure colored, and the ſuſpended ſulphur muſt be precipitated by acids; the contrary of which has been experimentally proved, by the addition of all the mineral acids; which, far from cauſing a precipitation or milkineſs, which they muſt in mere ſolutions of ſulphur; they expelled the native acid of the water, with the phlogiſton; yet, preſerved the terrene parts in rather a more perfect ſtate of ſolution, rendered the water more limpid, than it was in the natural ſtate, and preſerved it ſo. Thus, and thus onely, I conceive all the waters, ſayed to be ſulphureous, will be found impregnated, not with actual ſulphur, but with it's principles. The nonobſervance of which has been productive of as much confuſion, in the notions and practice of ſome phyſicians, as their conſidering ſome waters as actually ſulphureous, and poſitively aſſerting them to be ſuch; when they have been found, on juſt trial, to want every criterion of ſulphureous waters of either kind.

§ 397. But, before we procede further to apply our analyſis of theſe waters to practice; whileſt we wiſh to illuſtrate their virtues upon true phyſical and chemical principles, and ſhew what may be rationally expected from them; it is fit, we ſhould, in ſome material inſtances, point out what is not to be expected from them; that is, explane, at the ſame time, what they can, and what they can not perform.

§ 398. BERGER [a] and HOFFMAN with ſome others,

[a] The firſt goes further, in the ſame tract before cited, p. 115. and aſſerts, that they nearly agree with the waters of Carol's badt, Bath and Bourbon, in mixture, temperature, virtues and qualities. His words are, ſpeaking of Carol's badt, Quodſi harum contentio fiat aquarum, et comparatio cum thermis Aquiſgranenſibus, in Germania inferiore, itemque cum Bathonienſibus, in Anglia, et cum Borbonenſibus, in Gallia, eas omnes ut prope mixtione partium et temperatione, ſic fere viribus et facultate, convenire, deprehendemus. This, probably, is the bait, which our writers and practitioners ſeem to have ſwallowed, and made them think theſe waters analogous to each other.

who

who take the matter upon truſt from them, as one of them ſeems, in ſome particulars, to have taken it from the other; makes this neceſſary, when they, by aſſerting an ochrous or martial earth to be depoſited by theſe waters, inſinuate that they agree in virtues with thoſe of our Bath, Carol's badt and others, which, by depoſiting ſuch a ſediment, as well as from other trials, appear to be ferrugineous.

§ 399. It has already been ſhewn, from the appearance of the ſediment, as well as by experiments, that there exiſts no veſtige of iron, or any other metallic matter in theſe waters; and that therefore, the attributing to them the qualities or virtues of any chalybeate waters or ferrugineous baths is altogether vane and imaginary; conſequently, in practice, erroneous, fallacious and dangerous.

§ 400. Now, to ſhew what theſe waters can do. This is not the eaſieſt part of my taſk. It is not eaſy to obſerve the juſt medium; for, as few writers or practicioners keep within the bounds of mediocrity on this head; one is more likely to ſay too much, than too little upon the occaſion.

§ 401. The world abounds with diſſertations upon all the much frequented mineral or medicated waters, whether hot or cold. And therefore, it may ſeem but trivial, if not ſuperfluous, to attempt any further illuſtration of a ſubject ſo extenſively, ſo laborioufly treated by numberleſs other hands. But, when we come to conſider the genius's and circumſtances of the generality of writers on this head, and their works, the fruit, by which the trees are ever beſt known; we ſhall be perſuaded, that the world ſtands ſtill in need of a more juſt and acurate inveſtigation, than has yet been offered, or perhaps, than I ſhall be able to give, though I hope to bring many important truths to light.

§ 402. Few or none have ſat down to write expreſsly upon any particular water, that have not labored under ſome of the following diſadvantages; to wit,

wit, either living too remote from, perhaps without ever ſeeing, the ſource; conſequently, under the neceſſity of taking many, if not moſt, things upon truſt; and wanting much, if not the principal, informations to make them competent judges of the ſubject. Thus, BERGER and even HOFFMAN are not to be regarded, when they ſpeak of the waters of Aken, Bath and others, which they never ſaw.

§ 403. The other diſadvantage, I had like to have ſayed diſqualification, ariſes from a contrary cauſe; that of living upon, or by, the ſpot, and being intereſted in ſetting off the waters to the greateſt advantage. To ſay nothing of the incapacity of moſt of this later claſs, which I ſhall here ſubmit to the judgement of the candid enquirer, I can not look upon many of their productions, in a much better light, than that of a common quack-bill; in which ſome diſguiſed drugg, of unknown, uncertain, or perhaps dangerous efficacy, is moſt pompouſly extolled, as a Catholicon; never forgetting to tell where the Doctor lives. The evidence, men give upon theſe occaſions, ſhould be grave, deliberate, modeſt and ſtrong, to keep it free from ſuſpicion of ignorance, forwardneſs or fallacy. But, to what degree of credit can thoſe writers be intituled, who extol the water, of which they treat, beyond all bounds, even as an object of adoration? Who impregnate it with every thing, for fear it ſhould be deemed good for nothing? And who do not baulk at attributing to it, principles and qualities, which it neither had nor poſſibly could poſſeſs, in order to give it the preference to all other waters or forms of medicine? Who would make us believe, that thereby, all diſorders incident to the human frame may be, cito tute et jucunde, cured, innuendo, with the help of the author? And who therefore give or preſcribe them to all patients, in what diſtemper ſoever, promiſcuouſly; in ſome quantity, though it be but enough to ſwear by; while conſtant care is taken to drench the ſinking ſufferer,

ſufferer, with an immenſe variety of incongruous ſhop-medicines, enough to render the beſt water uncertain in it's operation, and therefore uſeleſs, if not hurtful? Such men, by their writings and practice, amuſe the deluded multitude for a time; but, in the end, they render the imputed virtues of the waters ſuſpected, and with them, at length, ſink themſelves into contempt and infamy, with the judicious.

§ 404. An other claſs of men, whoſe teſtimony is generally of as little, if not leſs, weight, than any of theſe, are the phyſicians, who like birds of paſſage, if not of prey, attend ſome particular water, at certain ſeaſons. Theſe are, for the moſt part, men, who are under no neceſſity of writing to proclame their own fame, or that of the waters. They have found other means of eſtabliſhing a reputation; perhaps, by the dead underſtanding of dead languages, in an univerſity; by a numerous acquaintance, an extenſive kindred, powerful alliance, or the weight of private fortune. Such a practicioner migrates to ſome water, whoſe renown ſome others had before eſtabliſhed; where, if he does not deck himſelf with borrowed, not to ſay ſtolen, plumes, he ſits himſelf down in a neſt of another's building. This gentleman's general capacity is no more to be queſtioned, than the clearneſs of his knowledge of the qualities, virtues and uſes of this water in particular. He ſays, his favorite water does wonders; his friends ſay, with the Doctor's help. To him then, and his water of life all, that wiſh for health, muſt have recourſe. Attend to this great man's great practice; his actions, not his words, ſoon ſhew, the ſum total of his knowledge balances that of his integrity; that it is all low craft, and that he makes but the firſt character in the ſtrolling drama, that acts the farce of Phyſic. See his nice diſcernment, when he ſcrupulouſly diſtinguiſhes one ſpring from another, in which neither nature made, nor art ever could diſcover, the leſt eſſential difference! And admire the extreme caution, with which he diſpenſes waters by the ounce, to the

the moſt robuſt, that could hardly produce any extraordinary effects given by the pound to the moſt weakly!—But, what degree of aſſumed pomp, imaginary greatneſs, pride, arrogance or matchleſs moroſeneſs could protect one of thoſe haughty ſages from being lauged into ſcorn, were his Recipes, however carefully recorded, but publickly ſeen, in which he often preſcribes, perhaps after a manna or ſaline purge, and ſometimes after other medicines, in theſe or the like terms;—poſt quam, bibat uncias quatuor aquae thermalis, vel cyathum theae viridis?—after which, let him take four ounces of the thermal water, or a diſh of green tea?—O! mighty monarch of medicine! is your thermal water of ſuch wonderful efficacy, as to produce extraordinary effects upon adults of either ſex, or to be advantagious to any thing, but your coffers, in this doſe? Or, do you mean ſhortly to give up the long-held reins of government, to abdicate your thermal throne, or make your paſſive ſubjects rebel; by letting Indian weeds take place of your long-revered and long-propitious houſe-hold gods? Are we really to judge your boaſted thermal waters no better than green tea? Why then do you keep patients with you, that can have tea any where elſe, as well? Or, is this a new diſcovery? Surely then you will repent of having gained ſo much by this ſordid craft, and will at length make the beſt attonement in your power to the deluded multitude.—From men of this caſt, it is madneſs to ſuppoſe we ſhould learn the real qualities and virtues of theſe or of any other water: Such are generally more ſollicitous to make the waters ſubſervient to their own private intereſt, than to the public good.

§ 405. However ſmall the credit due to theſe intereſted writers and practicioners may be, ſtill leſs regard is to be had to thoſe phyſicians, who abſolutely ignorant of all waters, except upon ſuch groundleſs teſtimonies, as theſe now given; after trying the whole

compaſs

compaſs of the therapeutic part of phyſic in vane, ſend their miſerable patients, with ſad aſſurances of ſucceſs, to ſome unknown baths or other medicated waters.

§ 406. Nothing is to be taken upon hear-ſay in phyſic. The phyſician can not be too diligent, or too cautious in his enquiries. The life of man is of too great importance to be trifled with. In the courts of law, the lives of criminals can not be put to any peril, without competent evidence. Shall the guardians of men's health procede upon worſe principles?— Surely they deſerve not the honorable name of phyſician, who do. Yet, this is not onely the univerſal complaint, even to a proverb in our days, but has been early complained of by ſome grave authors, particularly FALLOPIUS[a], who juſtly lays it down, as a poſitive and weighty precept, to be diligently obſerved by every phyſician; that it be ſtrictly enquired into and determined, whether water drinking be proper or not before it be preſcribed; without which no deſireable end may be hoped to be anſwered. He obſerves, that regardleſs of this, the modern, as well as the antient phyſicians, even up to the time of GALEN, were led into dangerous errors. There are, adds he, ſome phyſicians, who, after harraſſing the ſick, with an immenſe variety of medicines, ſometimes too, beyond all reaſon and bounds, ſeeing no proſpect of ſucceſs, immediately, precipitately ſend their wretched patients to ſome baths, as to their laſt refuge, without having previouſly conſidered whether or not the waters be fit; and thus, from their ignorance of the nature of the waters, as well as that of the diſeaſe, or perhaps of both, commit all to the guidance of blind chance. The good or ill, they do, depend alike upon accident.

§ 407. That ſhining ornament of our country, I might have ſayed of mankind, the firſt of Philoſophers and the beſt of men, our immortal BOYLE, with his uſual mildneſs and modeſty, expoſes the ſhameful

[a] De Therm. c. iii.

neglects

neglects and ignorance of the phyſicians of his time, with reſpect to mineral waters. "I expect it will be wondered at," ſays that excellent philoſopher,[a] "that ſo many enquiries ſhould be propoſed, and ſo many things directed to be taken notice of, about a ſubject, that has been thought ſo barren, that men are wont to think their curioſity great enough, if they enquire what colors the mineral water will ſtrike with galls or oaken leaves, and do obſerve what kind and quantity of ſalt will remane after the evaporation of the liquor. And I much fear, that ſome, even of the profeſſion of phyſic, will think, I cut them out a great deal too much work, by ſo many troubleſome queries and trials." And afterwards, he adds, "I have made the leſs ſcruple to be ſomewhat ample in the enquiries I propound; becauſe divers obſervations have perſuaded me, that phyſicians ought to conſider very well both the nature of the waters, they ordain, and to what perſons, for what diſeaſes, and in what manner they preſcribe the uſe of them: For, though many look upon them as ſuch innocent medicines, as, if they do no good, can at leſt do no harm; yet, the effects, that have too often enſued the unſkilful uſe of them, eſpecially when it was too long continued, allow me not to look upon the drinking of mineral waters as a ſlight thing, that may ſafely be played with, but as that whereby we have ſeen, as very much good, ſo a great deal of miſchief, done; eſpecially, ſome time after the operation is thought to be quite over, and perhaps almoſt quite forgotten."

§ 408. I would not have it imagined, that I place all the healing art, whether conſtantly or occaſionally practiſing at any particular medicated water, in this hateful rank. God forbid! I know too many men of extenſive learning, of profound phyſical erudition, and

[a] In his ſhort memoirs for the natural hiſtory of mineral waters. §. I. N° 7.

approved

approved worth and probity among them, here, as well as abroad, to admit of ſuch abſurdity or injuſtice. But, as it may not be allowable, in me, otherwiſe to point out or perſonally to diſtinguiſh the one from the other, than by drawing general characters; I muſt leave every reader to judge from theſe, whom I muſt mean. Some, I hope, may be found ſo generous, as to believe there are none crept into the noble profeſſion of phyſick, corrupt enough to practice theſe baſe and deſtructive arts. I wiſh it may ever be found ſo. But, if ſuch men there be any where, whom the cap fits, let them wear it, that the unwary public may know them by the hateful mark. On the other hand, if there be none ſuch, theſe bad characters may be looked upon as imaginary; ſuch as ſuit no body living, and conſequently, ſuch as can offend no man alive.

§ 409. He, that is touched with a juſt ſenſe of truth, will ſhew it in all his life and actions; eſpecially when he treats on a ſubject of ſuch importance to the life of man, as any branch of phyſic, this in particular, muſt be. Therefore, keeping clear as poſſible of ſuch teſtimony, as with the truth, blend more than the truth; ſuch, as will not give the whole truth and nothing but the truth in evidence; and ſuch as never did or could come near the truth; I ſhall procede in this, as in other parts of this work, upon obſervations drawn from actual experiments, ſupported by the authority of men of the moſt approved knowledge, and of unqueſtioned, indeed, of unqueſtionable judgement and probity in the profeſſion.

§ 410. Whoever underſtands the oeconomy of human life muſt ſee, that all the diſtempers, incident to the frame, ariſe from obſtructions of one kind or other. Theſe, according to the nature of the part or parts affected, and to the ſmartneſs or ſlowneſs of the attack, produce acute or chronic diſeaſes, of more or leſs danger and difficulty of cure.

§ 411. Since the time of David at leſt, we have joined with the royal ſinner, in making the ſhortneſs

of

of the life of man one of our penitential complaints: Yet, ſuch is our perverſeneſs, that, from infancy to old age, we are in nothing more induſtrious, than in laying the foundation for, and verifying, this complaint: The infant from his birth is overfed, ſtuffed and crammed with paps and puddings, perhaps with ſtill groſſer meats, till he is put into his own ward, in which he rarely, if ever, fails of completing the work his pampering parents, or their unnatural ſubſtitute, the nurſe, began. In his aparel, the like ſupernatural care is commonly taken. He is buried in cloaths, kept out of the wholeſom air, which, is often as carefully excluded, as a peſt; till he is made as ſoft, delicate and feeble, as an Aſiatic; unable to bear the ſlighteſt changes of air, without rheums and other ſuch like calamities. And thus are the principal comforts, the props of life ſo abuſed, as to leave us no room to doubt, that more human beings ſuffer from a redundance, than from a penury of the good creatures neceſſary to life.

§ 412. It is not expected, I ſhould here give a complete courſe of pathology; though without it, I am not to hope to appear perfectly clear to the generality of readers. If I were to give the hiſtory, ſigns, ſymptoms, prognoſtics, and method of cure, of the variety of diſeaſes, in which theſe waters might prove ſalutary, I ſhould extend this eſſay to the bulk of ſome maſſive volumes. I muſt therefore, leave this to the practical writers, whoſe excellencies are ſummed up in that noble compendium, left us by the great BOERHAAVE, and his worthy commentator[a]; while I humbly aſſiſt in miniſtering to them the rational uſe of a moſt ſafe and powerful remedy.

§ 413. As the foundations of moſt diſorders, the chronic in particular, are layed in obſtructions of one kind or other, the removing them by juſt and rational

[a] GERARD. VAN SWIETEN, Med. Doct. Comment. in HERM. BOERHAAVE Aphoriſm. de cognoſc. et curand. morbis.

means

means muſt be the phyſician's firſt care. The diſorders, which ariſe from theſe cauſes, are but ſo many efforts of parent nature to ſhake off the morbid matter, and to reſtore the oeconomy in general to it's proper functions. In this, ſhe generally, providentially points out the method of cure. Wiſe and happy is the phyſician, who learns and ſeconds her views!

§ 414. Plethora and obſtructions, with the evils, that attend them, are in general, moſt immediately relieved by evacuations. But, great ſagacity is neceſſary to determine how, or whence, the neceſſary evacuation is to be promoted.

§ 415. In this, as in many other inſtances, the beſt precepts are to be drawn from the divine ſage [a], who tells us, that ſuch ſpontaneous diſcharges, as are found beneficial, ſhould be promoted; but, that ſuch, as are not ſo, ſhould be reſtrained. By which he does but point out how nature is to be attended to and followed; well knowing, that ever watchful and ſolicitous to do good, ſhe frequently finds means of ſeparating the vitiated from the ſound juices, and caſting them from the oeconomy by the moſt ſafe and effectual emunctory.

§ 416. The indiſcriminate uſe of common purging medicines can ſeldom contribute to relieve effectually plethoric or obſtructed habits: For, beſides the ſickneſs and nauſea, griping and anxiety, loſs of apetite, with laſſitude and dejection, commonly attending the ill-judged uſe of cathartics, thoſe of the harſher claſs eſpecially; they, at beſt, cauſe but a promiſcuous diſcharge of the contents of the firſt paſſages, whether in an healthful or morbid ſtate, without otherwiſe working any ſenſible depuration of the juices. Moreover, inſenſible tranſpiration by the pores of the ſkin, of all others the greateſt and moſt important

[a] HIPPOCRATES, Aphoriſm. 2. § 4. In medicamentorum purgantium uſu, qualia etiam ſponte prodeuntia utilia ſunt, talia e corpore educere convenit; quae vero contrario modo prodeunt, cohibere.

diſcharge, is always interrupted or obſtructed by the operation of ordinary purgative medicines; according to an eſtabliſhed axiom [a], lax bowels, obſtructed pores, and the reverſe; and to the ſentiments and experiments of SANCTORIUS, backed by LISTER [b], who ſhew us how injurious harſh purging proves, how uſeleſs in preventing diſorders, when the body, lightened by ſuch evacuation, with offended bowels, is ſuddenly reſtored to it's former weight, by the extraordinary interruption given to perſpiration.

§ 417. The injuries to be juſtly apprehended from medicines of this claſs are not at all to be feared from the rational uſe of theſe thermal waters; whoſe operation and efficacy depend upon the inſpiriting, warming, diluting, reſolvent and abſterſive qualities of their compoſition. Thus, while the warm water ſoftens and relaxes the fibres, and reſolves crudities in the firſt paſſages, it's ſubtil volatile parts, together with it's ſalts, penetrate into the moſt remote receſſes of the animal frame, attenuate viſcid humors, diſſolve unnatural coheſions and concretions, and by gently irritating the nervous coats of the ſeveral veſſels, promote the natural diſcharges by the fitteſt emunctories, without pain, waſte of ſtrength, or interruption of tranſpiration.

§ 418. In proof of this, I have the concurrent teſtimony of the beſt writers, the moſt approved practicioners, and the moſt obſervant patients, that have conſidered or experienced the uſe and efficacy of theſe waters. Though ſuch evidence can hardly be ſuppoſed wanting, where the nature and quality of the compoſition has been ſatisfactorily explaned, which I hope it will appear by the foregoing experiments and obſervations to have been done.

[a] Alvi laxitas, cutis denſitas, et è contra. [b] Aphor. xlviii. § 1.—Claro ſane documento, quam inutiles fere ſint vehementes quaeque purgationes, certe ad morbos precavendos, cum corpus, vitiatis viſceribus, ad idem pondus tam cito revertatur.——— LISTER. Comment.

§ 419.

§ 419. Neither the ſmell or taſte of the water is at firſt taking agreeable; on the contrary, the ſmell offends the delicate, and makes them ſwallow the water with ſuch reluctance, as ſometimes to turn the ſtomach. But, both in time grow familiar and to ſome even agreeable. I confeſs myſelf in the number of the later, perhaps phyſically prejudiced in it's favor: For, I had it taken up an hour or two before dinner, and drank it as common beverage at meals.

§ 420. It's operations, which depend upon the nature of it's component parts and the conſtitution of the patient, vary according to the manner and quantity, in which it is taken, and the particular diſpoſition of the patient. In general, it may be looked upon, as agreeing well with the ſtomach and inteſtines, and proper to promote the diſcharges of the alvine, as well as renal excrements, without any pain or ſenſible irritation; and by both paſſages, to free the oeconomy from much groſs, offenſive filth, without any diminution of ſtrength or ſpirits; without heating or cauſing thirſt; but, on the contrary, by diluting the juices and gently relaxing the ſolids, it gratefully ſlakes thirſt and moderately cools the whole frame; whileſt, at the ſame time, it promotes perſpiration, raiſes the ſpirits, and creates an apetite. But, it's effects are ſometimes more ſenſibly determined to one emunctory, than to an other, either by the particular habit of the patient, or the manner of adminiſtering the water.

§ 421. Perſons of exquiſite delicacy, it will ſometimes occaſion to vomit, as before obſerved. But, that is accidental, not any eſſential property of the water. Thoſe, whoſe bowels are foul, loaded with crudities, eſpecially if tending to aceſcent putrefaction, will be purged by them, eſpecially if taken in an advanced doſe; whileſt with all, they paſs ſenſibly by the urinary paſſages and pores.

§ 422. They affect the head lightly, eſpecially at firſt taking, with a ſenſe of gaiety and chearfulneſs; but, in an increaſed doſe, eſpecially, where they do

not purge, they cauſe an heavineſs and propenſity to ſleep.

§ 423. All theſe effects are eaſily, rationally accounted for from the conſtituent parts of the water. It's mineral ſpirit and other volatile parts, like thoſe of other ſpirituous mineral waters, find a ſhorter paſſage to the grand ſenſory, than by the ordinary courſe of digeſtion; they greatly attenuate and greatly rarefy the juices, and by their expanſion in the brain, before they paſs off by the pores or otherwiſe, give this ſenſation. Theſe active parts are the means, which, aſſiſted by the heat of the water, promote perſpiration. This is evident from the laxneſs and ſoftneſs, which they ſoon give the moſt denſe and arrid ſkin. The color, this perſpirable matter gives, proves how it is promoted and impregnated: The linen is colored yellow with it; and ſilver borne in the pockets, during a courſe of this water, is tarniſhed, yellow firſt, and then black; whileſt the whole body of the patient contracts much of a ſulphureous ſmell. It's ſalts explane it's aptneſs to paſs by the urinary channels, and it's purging may be accounted for upon the ſame principles, as well as from it's earth, which gives a kind of Magneſia alba. Why it ſhould become more purgative, where there is moſt acidity, is obvious from all lixivial ſalts, as well as this kind of earth's becoming ſo, upon being neutrated or ſaturated with acids. Upon this principle it is, that this water blunts acidity in the ſtomach and inteſtines, and cures thoſe ſour belchings and heartburn, as it is called, which attends crudity and acidity in the firſt paſſages. In ſhort, it will be found, that the Aken water, together with the powerful volatile principles, poſſeſſes all the qualities attributed to their nitre by the antients in general, THEOPHRASTUS, DIOSCORIDES, AEGINETA, GALEN, and PLINY, in particular, as well as thoſe of BACCIUS, AGRICOLA, FALLOPIUS, and others. Their ſentiments, with reſpect to it's reſolvent, deterſive and aperient qualities, are ſummed up in the words of GALEN[a], who tells

[a] De ſimp. med. fac. l. ix.

us, that nitre is drying and digeſtive; and, taken internally, incides and attenuates groſs and viſcid humors, more powerfully, than ſalt.

§ 424. From theſe conſiderations, it muſt appear to every competent judge, in what caſes theſe waters are proper; in what caſes they are improper; and what may, and what may not, be expected from them.

§ 425. The uſes of theſe thermal waters are two fold; 1. internal, and 2. external. The external is two fold alſo, 1. General or partial bathing of different kinds; 2. Receiving the vapor upon the whole, or ſome particular part of the body, which is called, the Vapor Bath; of each of which a word apart.

XIV. *Of the internal uſe of the thermal waters of* AKEN, *in particular.*

§ 426. From the premiſes, we may be reaſonably allowed to conſider theſe waters in the ſame light, as a ſaponaceous medicine, whoſe reſolvent and abſterſive faculty is acuated by the action of certain moſt ſubtil and volatile parts. Their operation in the oeconomy is certainly to be accounted for upon theſe principles: The heat of the ſtomach ſoon expels theſe ſubtil and penetrating ſpirits; which, like other active and volatile matters, find a quick paſſage to the brain and other nervous parts; where they firſt make the impreſſions before obſerved, and then fly off by the pores; where their effects are manifeſted, as before mentioned; whileſt the water, with the more fixed matters, the earth and ſalts; being now more acrid, by being freed from thoſe, as appears by experiments; acts firſt upon the ſtomach and inteſtines and their contents, relaxing, ſoftening and cleanſing the one, blunting the acidity of, and reſolving and digeſting, the other; and ſecondly, by gently ſtimulating the nervous fibrillae of the inteſtines and other veſſels, promoting the firſt and ſecond digeſtions, with all the other neceſſary ſecretions and excretions.

§ 427. Hence, we may ſee, that theſe waters are to be adminiſtered, in all ſuch diſorders, as deduce their origine from indigeſtion, from acidity, from crudities and other foulneſſes in the firſt paſſages; which, ſooner or later, carry their evil effects to the other bowels, and, by inducing a viſcidity of the juices, bring on ſuch obſtructions as vitiate the general oeconomy; and that, with the moſt rational proſpect of ſucceſs; as we find them well qualified to promote all the curative indications.

§ 428. From the infinite number of mankind, who, by affluence, and pride, are prompted to lead ſloathful and inactive lives, indulging in all the exceſſes of luxurious tables and downy beds; we need not be ſurpriſed at finding the diſorders ariſing from crudities ſo numerouſly and variouſly branched out, as they appear in our days. Gluttony, or exceſſive feeding, has however been obſerved a common and deſtructive vice in every age and country, where opulence prevaled. Upon theſe, the ſevere curſe of a long train of maladies, deriving their cauſes from crudities, has always been intailed. So ſenſible was GALEN of this capital evil in the oeconomy of life, with all it's numerous train of dreadful conſequences, that he ſeems to have looked upon it, as the cauſe of the worſt diſeaſes incident to man; when he judges, that men may outlive any diſeaſe, who take care to avoid contracting crudities [a].

§ 429. The generality of chronic, as well as many acute, diſeaſes, owe their origine to this foul cauſe. To this account, we may fairly charge the long catalogue of maladies attending luxurious and inactive which are in no country more prevalent, than in ours; ſuch as indigeſtion, acidity in the ſtomach and inteſtines, and their conſequences, general obſtructions, melancholy, hypochondriac and hyſteric affections, coſtipation of the belly; with curdlike excrements, ſuppreſſion of the natural diſcharges in general, of the menſtrual, in particular. It is eaſy to conceive

[a] De Cibis boni et mali ſucc.

how

how theſe complaints are corrected by Aken waters; upon conſidering the attenuent, diluting, ſweetening, reſolving, aperient, diuretic, deobſtruent and diaphoretic qualities of the waters; which, I flatter myſelf, have been clearly made out before, in explaning the nature and uſe of ſimple waters, as well as in the analyſis of this water. But, to be more particular;

§ 430. Is the ſtomach oppreſſed with indigeſtion, with crudities, with putreſcent acidity, the conſequence of furfeiting and inaction? are it's coats furred and fouled, it's apetite loſſed, it's functions in general interrupted, and perſpiration of courſe obſtructed from this cauſe?—Nothing can ſo effectually relieve ſuch complaints, as this ſpirituous, ſaponaceous liquid, which at once attenuates the viſcid humors, reſolves the crudities, corrects the putriſcency, blunts the acidity, deterges and cleanſes the foulcoats of the ſtomach and inteſtines, promotes digeſtion and perſpiration, and regulates the natural diſcharges.

§ 431. Is the reſt of the inteſtinal channel furred and fouled, charged with groſs and mucous matters; or overloaded with hard, dry excrements, which impede chylification and nutrition, bring on a thin, lean, hot habit of body, with a tenſe or coſtipated belly, continual oppreſſion and anxiety of ſpirits, conſtant gnawing pains between the hips, aches and confuſions in the head, heat, thirſt and reſtleſsneſs?—Nothing can ſurely anſwer the curative indications, in theſe complaints, from the aforeſayed cauſes, more effectually, than a warm, active, penetrating, ſaponaceous liquid; that muſt waſh and cleanſe the inteſtines; reſolve the viſcidity; diſſolve and protrude the excrements; open and free the lacteal pores and ducts; relax and mollify the whole fibres of the frame; cool, aſſuage thirſt, and derive the humors from the head downwards. And this daily experience confirms, in the relief of numbers of melancholic, hypochondriac, hyſteric and other obſtructed habits of body.

§ 432. Have the evils of theſe indigeſtions and

crudities been carried further, to the vitiating the whole maſs of humors; to rendring the blood thick and ſizy; to the obſtruction of the meſenteric or other glands; to the oppreſſing and clogging the lungs with viſcous matter, which brings on aſthmas; to the caſting terrene concretions upon the glands and membranes about the joints, and bringing on the gout; or to the depoſiting calculous concretions in the renal tubes or other urinary paſſages? What can give more effectual relief, than a diluting, attenuating, ſoftening, ſweetening, reſolvent, deterſive and diuretic liquor, ſuch as Aken water appears to be?—Nothing certainly can be thought to anſwer theſe curative indications better than this water is by experience found.

§ 433. Has this diſtempered ſtate of the blood brought on ſpaſmodic contractions, palſies or other nervous imbecilities?—No medicine more fairly promiſes or effects a cure, than ſuch, as removes the firſt cauſe; as the internal and external uſes of theſe waters are found to do in theſe caſes.

§ 434. Has this morbid maſs of humors brought on fevers of different kinds; which, coming to no regular criſis, have terminated in ſpaſmodic contractions of the ſmall guts; in obſtructions of the liver, ſpleen or meſentery, and induced bad concoctions, in the firſt and ſecond paſſages; unequal circulation and diſtribution of the juices, attended with a pale, ſallow complexion, jaundice, anaſarca or dropſy; with a ſuppreſſion of the menſtrual diſcharges in one ſex, and of the hemorhoidal in the other; and at laſt confirmed hyſteric or hypochondriac diſorders?—It is eaſy, from the nature of theſe waters, to ſee, what repeted experience confirms; their power and efficacy in relaxing preternatural conſtrictions and tenſions of the fibres of the ſolids in general, eſpecially of thoſe of the inteſtines; in diſſolving and diſcharging their contents; in mollifying the glands, and reſolving and removing their obſtructions; in thinning, and ſweetening the blood, and reſtoring a juſt circulation

tion and equal diſtribution of the fluids, and reeſtabliſhing, with the natural ſecretions and excretions, the principal vital functions, thus interrupted.

§ 435. Are there ſpaſmodic commotions or contractions, with cholic pains tenſion and coſtipation, in the ſtomach or inteſtines, ariſing from crudities or the irritation of acid humors in theſe paſſages?—Nothing more ſpeedily relieves theſe excruciating complaints, than the free internal uſe of Aken waters, in draughts and clyſters, ſeconded with bathing; before they bring on any conſiderable degree of inflammation; for reaſons before explaned.

§ 436. Or, does the thus induced general depravity of the juices prevent their free circulation, eſpecially through the ſmall veſſels on the ſurface of the body; and thereby, cauſe weakneſs, laſſitude, pains in the joints, limbs or loins; ſpots and eruptions on the ſkin; ſwellings of the glands, thoſe about the lower jaw eſpecially; and the other ſymptoms of this kind of ſcurvy and ſcrophula?—What, like theſe thermal waters, can dilute and attenuate the thus vitiated juices; blunt their acidity; and fit the morbid matter for ſalutary protruſion, by the deſtined emunctories?—Nothing certainly has been by experience found more effectual in ſuch diſtempers, than theſe waters; which are daily obſerved to cure dangerous internal, as well as the moſt contumacious external ulcers, with inveterate itch and other cutaneous foulneſſes, by ſeaſonable internal and external application, ſeconded by a regular diet.

§ 437. Or, does the ſharpneſs of the urine of ſuch evil habits, which may be always looked upon of the acid kind, give painful ſenſations in the kidnies, bladder or other part of the urinary ducts, attended with a diſcharge of mucus or glare? What can more effectually relieve ſuch a complaint, than a mild, alcaline ley, which is ſo attemperated, as not to hurt the eye, and which thins this excrement and blunts this acidity. This is experimentally proved in this thermal water; the uſe of which, not onely neutrates ſuch

acid

acid urine; but, even renders it alcaline upon long taking; as may be proved upon inſtilling the acid of vitriol into ſuch urine; for, before the water is drank, this acid has no ſenſible effect upon it; whereas after five or ſix pints are drank for ſeveral ſucceſſive days, it will be found, eſpecially towards the evening, to cauſe an ebullition. Hence, the effects of this water in gouty and calculous caſes, becomes eaſily explaned. The ſalutary uſe of ſuch waters in theſe complaints, whoſe cauſe and matter bear ſuch cloſe analogy, is authoriſed by all the writers, that treat of the virtues of the nitre of the antients, or of waters therewith impregnated; particularly, PLINY, STRABO, CAELIUS AURELIANUS, and SCRIBONIUS LARGUS.

§ 438. There are no perſons, in whom the powers and organs of procreation are found more languid and imbecil, more unfit for the great work of nature, than thoſe of either ſex, who, by full and groſs feeding, indolent, inactive and luxrious living, lay a foundation for plethoras, indigeſtions, foulneſs of the veſſels, a diſcraſy of the juices, and a general relaxation of the ſolids. Such perſons are too frequently put upon courſes, that rather increaſe, than correct, the malady. Men are taught to take the moſt nouriſhing high, rich food, ſaloop, ſago, vermicelly, with ſpices, acrid, ſtimulating and aromatic medicines; while the woman is cloyed with aſtringents and ſtiptics, till the preſent diſorders are agravated, or worſe induced. In theſe caſes, a light, ſimple, ſparing diet, moderate exerciſe and the uſe of theſe waters, muſt be found preferable to any other courſe known in empyrical or rational practice. The cure of theſe like imbecilities muſt conſiſt in freeing nature from the unnatural burden, thrown upon her by intemperance; in cleanſing the veſſels in general, reſtoring the juices to their natural balmy craſis, and eſtabliſhing the whole ſecretions and excretions of the oeconomy. To this, the duplicate ſalt in theſe waters muſt greatly contribute; ſince even the ſea ſalt alone has been al-

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ways looked upon, as ſuch an incentive to Venery, as to give us the word ſalacious; which the grammarians ſeem juſtly to derive from ſal, ſalt; which was uſed to make even the brute creation prolific; for which purpoſe, it was recommended by ARISTOTEL.[a] The Egyptian prieſts, well ſkilled in the ſecrets of nature and art, were ſo ſenſible of this quality of ſalt, that to preſerve a ſpotleſs chaſtity, in which they were more remarkably ſtrict, than any other clergy before, or perhaps ſince, were found; religiouſly abſtained from ſalt; according to PLUTARCHI[b], who thinks, the pagan fable, of Venus's ſpringing from the ſea, took riſe from this notion. And I doubt not, all the heathen mythology may be explained in the like manner; ſince in chemiſtry, the relations of the gods, whoſe names are given to the metals, and their qualities, are found, by ſome, very intelligible and juſt.

§ 439. From theſe conſiderations, the judicious will eaſily judge, who are and who are not fit ſubjects for a courſe of theſe waters, and determine in what conſtitutions and what diſorders, they may be expected to prove beneficial, uſeleſs or prejudical. They are, no doubt, to be looked upon as a moſt powerful medicine, of very extenſive, but far from univerſal, utility. And, as the indiſcriminate uſe of them may be found far from beneficial; I judge it expedient to point out here a general ſcetch of caſes, in which theſe waters may not be given with any deſireable ſucceſs.

§ 440. Though we may not in art or nature know a medicine of ſo great efficacy, as this water, or one, which ſo well agrees with different temperaments; yet, is it by no means to be looked upon, as a matter, that may be indiſcriminately uſed without danger of evil conſequences.

§ 441. If it ſhould be ſayed, that Aken water may agree with oppoſite complexions, and prove ſerviceable in the humid and cold, as well as in the hot

[a] Hiſt Anim. l. viii. c. 10. [b] Sympoſac.

and

and dry conſtitutions; it might, at firſt ſight, to ſome ſeem a paradox, if not ridiculous. But, the difficulty will be removed upon conſidering it's various operations. Whatever is actually warm, blunts acidity, thins viſcous and ſluggiſh humors, promotes the circulation of the blood and the diſcharge of ſerous humors by the pores and other emunctories, muſt reſtore the phlegmatic, cold patient to the natural warmth and vigor. This the rational uſe of theſe waters demonſtrably effects. And on the other hand, whatever is found to ſoften and relax arid and criſp fibres, to open obſtructed pores, and promote, that way, the expulſion of hot and ſharp humors, muſt reſtore the hot and dry temperament to the natural coolneſs and moiſture. And reaſon and experience concur in demonſtrating this to be evidently effected by theſe waters.

§ 442. Yet, there are particular inſtances in theſe kinds of caſes, where theſe waters can produce no ſalutary, and may cauſe evil and fatal effects. To inſtance ſome few for example.

§ 443. In all cold, phlegmatic diſorders, where, by long ſtanding, the fibres are extremely reduced and relaxed, with ruptures of the veſſels and extravaſations or lodgements of ſerous humors or lymph already made either in the interſtices of the muſcules, in the lower belly, in the cavity of the cheſt, or in the head; there, the internal uſe of theſe waters, inſtead of ſerviceable, muſt prove deſtructive; as it muſt ſuddenly increaſe the volume of the preternatural lodgements; and therefore, when ſuch are made in the head, and thereby cauſe, lethargies, epilepſies, the forerunners of an apoplexy, or any other interruption of ſenſe and motion; or when they are formed in the cheſt and cauſe convulſive coughs, and violent aſthmas; or lodged in the lower belly; there, drinking the waters muſt increaſe the malady, and cauſe ſudden, fatal effects.

§ 444. In hectic and tabid caſes in general, thoſe that

that attend loſſes, or great colliquation, thinneſs or ſharpneſs of blood, in violent fevers, and perſons of choleric habits, ſubject to eriſypelas or other bilious complaints, and of irritable fibres, in particular, theſe waters are not found beneficial. In ulcerations or eroſions of the lungs likewiſe, they are found improper.

§ 445. Though in glandular obſtructions and tumors in general, theſe waters be found very beneficial and powerful; yet in inveterate, indolent, ſchirrous tumors of the glands or bowels, little is to be expected from theſe waters, or perhaps, any other medicine.

§ 446. In hemorhages, in inflammatory caſes in general, the uſe of the waters are forbidden; eſpecially, in the acceſs of a fever, and in the gouty paroxyſm. But, when it's fury is ſpent, the internal, as well as external, application of this water will properly come into play. Some have a notion, that taken in the interval, they bring on a fit of the gout. This may be ſayed, with the appearance of truth, of thoſe waters, in which an acid is predominant, and which are extremely charged with ſtoney or terrene, as well as ferrugineous, matter. But here, I ſee no reaſon to apprehend it, from mine own or other's experience: I drank them myſelf for ſome months, to the quantity of a gallon a day. I bathed long and frequently in them, and often had recourſe to the vapor bath; yet, ſo far was I from finding this attended or threatened with the return of a fit; that I daily got ſtrength and the free uſe of the joints, before weakened or ſtiffened by the ſeverity of the inveterate hereditary diſtemper.

§ 447. The principal caution beſides, that occurs to be inculcated is, that as theſe waters produce a principal part of their effects by ſoftening and relaxing the fibres, ſtrict attention ſhould be had to the bracing and reſtoring the thus relaxed fibres to their due tone, where nature, though relieved from her burden, is found unable to redreſs her own grievance. This may be effectually done by cold bathing

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in the ſame habits, by the uſe of ferrugineous waters and other tonic medicines in others: For both which helps, Aken is happily provided. The ſprings of Seffen make the beſt cold bath; there is a pretty light martial water in the ſuburbs, an other, within a league of the town, at a place, called, In Den Eiken; and for thoſe, that require more powerful aid, in that way, Spa will not be found too far diſtant.

§ 448. It now remanes, that we ſay ſomewhat of the times, ſeaſons and manner of drinking theſe waters. Though it be evident, that the uſe of naturally hot or warm waters was known in the earlieſt ages of phyſic [a], and theſe not onely ſimple, but impregnated with ſulphur, bitumen and nitre; yet, the names, they gave them, of Thermae or Balnea, as well, as the ſilence of moſt writers with relation to their internal uſe, ſhews that the antients confined themſelves chiefly, if not ſolely, to the external application of hot waters, in baths, ſudatories, embrocations, &c. The general internal uſe of moſt thermal waters, now known with us, may be looked upon to have been introduced within little more than a century; and that, not without much difficulty and controverſy among the practicioners. In this BLONDEL, before mentioned, engaged, in the year 1655. with ſome acrimony; a moſt induſtrious and laborious writer, but not enough verſed in chemiſtry to be of great weight in the argument; though he is the firſt after BRUHESIUS, or BRUHEZIUS [b], within my knowledge, that wrote expreſly on theſe waters, and eſtabliſhed the internal uſe of them. However, I do not poſitively aſſert this for certain.

§ 449. As the temperature and virtues of theſe waters are found at all times of the year the ſame, they may be uſed with propriety in all ſeaſons. In the canicular days or other hot weather, the drinkers ſhould take them before the ſun has roſe to heat the atmo-

[a] HIPP. de aere locis et aquis, BAUCIS. de therm.

[b] PETR. BRUHES. de therm. Aquiſgran. viribus cauſa et legitimo uſu. Antverp. 1555.

ſphere and take care to keep themſelves cool and temperate, by regulating the air, their diet and exerciſe. And, on the other hand, in the extreme cold of the winter, the like caution is to be obſerved, not to expoſe the body, after drinking theſe waters, warm and perſpiring, to the ſhocks of an inclement air. In theſe extremes, it is plane, the waters may be drank, contrary to the received groundleſs cuſtom, and that with ſafety and ſucceſs; but, with moderation, deliberation and circumſpection.

§ 450. The making of certain determinate ſeaſons of the year, in which alone theſe or ſuch like waters may be ſafely or ſucceſsfully uſed, internally or externally, is a folly, which has too long prevaled at Aken and elſewhere, and ſhould now be laughed into contempt, and exploded. They may moſt certainly be uſed, as well internally, as externally, in all ſeaſons of the year, taking them onely early or late in the day, or in greater or ſmaller doſes, and with the other mentioned precautions, according to the heat or coldneſs of the ſeaſon. The phyſicians may make vacations for themſelves, if they think it conſiſtent with the duties of their profeſſion, or that their fortunes or conſciences will permit them, to deſert their poſts, at any time; but, they can not with truth or reaſon ſay, there need be any vacations or ſeaſons made for the waters, when ever patients can have convenient acceſs to them.

§ 451. From what has been ſayed, with reſpect to the ſeaſons of the year, the times of the day, fit for drinking theſe waters, may appear. Like all alterative medicines, they are beſt taken when the ſtomach is moſt empty. This is generally in the morning; which is therefore, the moſt proper time of adminiſtring them; eſpecially, where a diſcharge by ſtool is to be promoted. Though, like other alteratives, they may be taken in all the medicinal hours, that is, when the ſtomach is left engaged in the action of digeſtion, which is commonly three times a day, morning, noon and evening, about an hour before each meal; and

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in many caſes, after becoming by uſe familiar to the oeconomy, they may be taken at meals, as I myſelf took them with deſireable ſucceſs.

§ 452. The ſources, from whence they are beſt to be drank, may be diſcovered from judging of the different degrees of heat and impregnation of theſe waters; for, they differ in nothing elſe. Where the moſt hot waters and ſtrongeſt impregnation with volatile and other parts are moſt eligible, they ſhould be taken from the ſource of the Emperor's bath or the New bath, or for greater mediocrity, thoſe of the fountane, Cornelius's bath, Carol's bath or Roſe bath may be uſed; particularly, when the fountane runs no longer.

§ 453. To explane this, it is neceſſary to inform ſtrangers to Aken, that the wiſdom of the magiſtrates of that famed city has been ſuch, as to erect an handſome, well ornamented ſquare marble pillar, in the great ſtreet, where the principal ſource of the preceding baths ſprings. This pillar conſiſts of four equal ſides, to each of which there is a ſtone baſon affixed, into which the water runs by two ſpouts or fountanes at a convenient diſtance above the baſon. At the bottom of this baſon, is an opening, by ſtopping or cloſeing of which, the water is collected or runs to waſte. This pillar ſtands contiguous to a very handſom piazza, where the patients take their waters, recreation in walking, converſation, &c. Behind this, there is a pretty plantation of trees, layed out in rowes for ſhady gravel walks, and two Corridores or covered walks, well paved with marble. At the end of the one of theſe walks, there are ſeveral vaults and convenient offices for the gentlemen, that drink the waters, and at the end of the other, is a little neat ſquare, with proper accommodations for the ſex, to whom alone it is conſecrated. In theſe, any gentleman or lady may ſecure a proper ſeat, during their reſidence at Aken; than which, nothing can be more commodious or elegant. Within the pillar, a pump is placed, whoſe

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pipe of ſuction communicates with the chief of theſe ſources, near it's bottom. Over this, and quite out of ſight, a man is placed, who works the pump and ſets all the fountanes continually playing for the public, from between five and ſix to nine every morning. Here, moſt patients and others furniſh themſelves with water for the day. But, as I expect to ſee the uſe of theſe waters eſtabliſhed upon a ſtill more extenſive and rational footing; I hope to find the magiſtrates, who have hitherto been ever found ready to be at any expence or trouble, to promote the eaſe, ſatisfaction, and general good accommodation of ſtrangers, will order the fountane to be played from three, to ſix or ſeven in the ſummer mornings, and in the cooler ſeaſons, an hour or two at noon, as well as an hour or two in the afternoon. This will, at the ſame time, ſupply all the emergencies, that it improves the waters, which are ever found the better, the more frequent they are drawn. But, though it ſhould remane as at preſent, no patient can be much at a loſs for a glaſs, or any quantity, of the waters; ſince, the ſources of the ſeveral baths are open, at all hours, to the public.

§ 454. The doſe and manner of drinking of theſe waters is next to be ſettled. There is nothing more difficult, than to determine the doſe of theſe and ſuch like waters: It is chiefly to be made out by the manner of giving them, and that depends on the particular caſe of the patient and the intentions to be anſwered. No perſon ſhould begin with above half a pint, and many ſhould ſet out with half that quantity, or leſs. Where, regard is had to the volatile parts, the nearer the ſource and the quicker they are drank, the better. All, that are able, ſhould, in ſuch caſes, take them upon the ſpot; and if the weather be moderate, walk gently about to keep up the proper degree of heat. If the weather be hot, they are to take them in the ſame way, uſing but little motion and keeping in the cool air and ſhade, for fear of overheating the blood. In the

colder ſeaſons, the more robuſt ſhould likewiſe take them at the ſource, and uſe as much exerciſe, as will keep up and cheriſh the native heat; whileſt the more tender and delicate, at ſuch times, ſhould take them in their beds, or in warm chambers; ſeeing they be brought with expedition in bottles well ſtopped from the hotteſt ſources.

§ 455. After the firſt glaſs, ten, fiveteen or twenty minutes is to be interpoſed, between that and the next, according as the ſtomach is able to retain it, without offence, or to paſs it, without inconvenience. As ſoon as the ſtomach is found to paſs ſome minutes at eaſe, without ſickneſs, loathing, fulneſs or oppreſſion, after the firſt glaſs; a ſecond may be taken in the like manner, and ſo to a third or fourth. But, moſt perſons, the more delicate eſpecially, ſhould content themſelves with one glaſs or two for the firſt day or two, and increaſing to a third, the ſecond day; continuing two or three days to take that doſe onely; then augmenting it, as need requires, by a glaſs in three or two days, till the quantity, judged expedient for the particular caſe and emergency, be taken. From this and the operation of the water, the doſe is to be determined. Where cleanſing the firſt paſſages is the chief view, it is to be drank in larger draughts and oftener repeted. Some are purged with a quart or three pints, whileſt others are not thus affected by a gallon. Where it purges, it's operation is to be limited by the number of glaſſes; for, every one taken after the firſt motion, generally occaſions another. Where it leſt purges, there it paſſes moſt ſenſibly by the urinary paſſages, or the pores of the ſkin. When the former is the indication, it is to be drank more ſlowly than with the purgative view; and when the later intention is attended to, it is to be given in a ſtill ſmaller quantity, and more ſlowly. Thus, it is to be given in ſmall quantities, repeted at proper intervals, and gradually increaſed and continued, in ſuch proportion, and for ſuch time, as is found neceſſary to anſwer the deſired purpoſes. After which, it is not proper to quit it ſuddenly; but, to avoid

void ſhocking the oeconomy with ſudden changes, it is beſt to leave off the uſe of the water ſlowly, as it was begun; that is, by diminiſhing the quantity at the end of the courſe, in the ſame manner, as it was increaſed at the beginning. And thus, given to fit ſubjects, with due care and caution, for a proper length of time, it can not fail of producing the moſt deſireable effects.

§ 456. Where theſe waters are intended merely as alteratives, eſpecially in inveterate chronic diſeaſes, they may, with great propriety and efficacy, be taken between meals; as an hour before dinner and an hour before ſupper, as far as a glaſs or two may be agreeable to the ſtomach. And, in bad digeſtion and ſourneſs in the ſtomach and bowels, a glaſs at, or ſoon after, meals will be found very ſerviceable, as it promotes concoction and corrects the ſuperabundant acidity. Weakly and emaciated perſons may take them with a jill or more of aſſe's, or mare's milk in the firſt glaſs, or a ſpoonful or two of cow's milk in every glaſs of the water; by which means it will at the ſame time become a reſtorative and an alterative.

§ 457. Some practicioners are very ſtrict and formal in preſcribing preparatories to the uſe of this and ſuch like waters; ſuch as different kinds of evacuations, chiefly by purging, and thoſe ſometimes repeted. But, this is for the moſt part ſuperfluous: For, though in very plethoric and ſanguine habits, blood-letting is always to be premiſed; yet, where there is merely a fulneſs or foulneſs in the firſt paſſages onely, the waters will generally do the office better, than any ordinary purge. However, leſt in ſuch plenitudes, they may occaſion offenſive belchings, loathing or ſickneſs, at the firſt taking; and even after, occaſion the taking them with repugnance; it may, in ſuch caſes, be expedient to premiſe a mild vomit, or a gentle purge or two of the ſaline kind; ſuch as Epſom or Sedlitz, or Glauber's ſalt, ſoluble tartar, or ſal polychreſt, with or without manna, or an infuſion of rhubarb and ſenna,

with any of theſe ſalts in plane, or in the thermal, water. But, the ſimpleſt and beſt preparatory, where a very extraordinary fulneſs does not require a more ſudden, powerful, previous evacuation, is the very thermal water, let to ſtand open, till it's heat is conſiderably abated and it's volatile parts, which are the moſt apt to affect the ſtomach and head, are diſſipated. This will be more effectually done by heating it gradually to the degree of boiling water; then letting it ſtand open to cool and make the earth ſubſide. By this means, the water will not be apt to offend the ſtomach or affect the head. And, as it will be then leſs diaphoretic, having loſſed it's moſt ſubtil and penetrating parts; ſo it will prove more purgative.

§ 458. The water thus altered and pretty cool, will be found to anſwer very well with ſome patients, in whom the unaltered water might, at firſt taking, otherwiſe cauſe offenſive heat, nauſea at ſtomach, and megrim or dizzineſs of the head.—And thus, it may be given at firſt, coming gradually near the natural ſtate, as faſt as circumſtances will admit; till at length the patients be by ſlow degrees brought to bear it in the utmoſt perfection, at the ſource.

§ 459. Thus, this water may ſometimes be made a preparative to a courſe of itſelf. And a ſhort courſe of theſe, external as well as internal, is, in moſt caſes, the moſt excellent preparatory for a courſe of Spa, or ſuch like ferrugineous, waters; which are never found ſo effectual, as when the body is univerſally cleanſed by the uſe of ſuch a ſaponaceous fluid.

§ 460. During the courſe of theſe waters, whether ſhort or long, the uſes of all the non-naturals, as they are called, is to be exactly regulated.

§ 461. 1. With regard to Air, it will be expedient to vary that, for ſuch as are able, either on foot, or in ſome fit carriage. For this purpoſe, the walks in and about the city and all the outlets are agreeable and convenient. The onely cautions requiſite in taking

the air, are to avoid the inclemency of the weather; extreme cold on the one hand and extreme heat on the other; with the damps, that fall after ſun ſet. Shifting the air to be breathed in any convenient manner, within theſe rules, will be grateful, proper and neceſſary.

§ 462. 2. With reſpect to food, ſolid and liquid; in general, none ſhould be taken with the waters, which are to be drank early in the morning, nor after, until the ſtomach is found quite free from them. Then a light, ſimple breakfaſt of gruel, chocolate, tea or coffee, milk or light broth to thin and waſted conſtitutions, with bread or biſcuit, ſhould ſuffice. The colder habits, in the colder ſeaſons of the year, may take a little mulled wine, or an egg beaten up with wine and water, and gently heated. For dinner, food of eaſy digeſtion and ſound nouriſhment, no way repugnant to the nature of the waters, nor the diſorder, ſhould be taken; ſuch as good ſoups, freſh fleſh and fiſh planely dreſſed, without thoſe deſtructive incentives to gluttony, high ſauces, pickles and the like; and in moderate portions; never loading the ſtomach, with any food, at any meal; for, this would make the courſe of the waters fruitleſs or endleſs. The ſupper ſhould be by the half lighter, than the dinner. The uſe of vegetables in general is to be moderate. The drink ſhould be at meals, ſuch as beſt ſeconds the virtues of the thermal water; ſuch are the waters of Selter or Bonn; which are had in the town in plenty and perfection, at a moderate rate; or the thermal waters let ſtand to cool. Such as are accuſtomed to the uſe of fermented liquors, may take ſome glaſſes of any generous wine after dinner and ſupper; and ſuch, as can not afford wine, may have recourſe to it's ſubſtitute, beer; but, either ſhould be moderately taken; as all exceſſes in them muſt fruſtrate the uſes of the waters; eſpecially, when they are found in any degree tending to ſour; for then they greatly alter the nature of the waters; as may be ſeen from the effects of acids

in the experiments. And as no fermented liquors can be free from acidity; the leſt acid are to be prefered, and even then but ſparingly uſed; unleſs where, from other motives, they may be found neceſſary. The meals ſhould be much earlier, than modern modes admit. Dinner ſhould not be later, than one, nor ſupper, than eight; breakfaſt when convenient.

§ 463. 3. 4. Exerciſe and Reſt, Sleep and Watching, are to be ſtrictly attended to, and duly regulated. Exerciſe ſhould be conſtant, regular and uniform, always within bounds; never in ſuch extremes, as to over heat the blood, to over fatigue the body, or exhauſt the ſpirits. Reſt is not to be indulged further, than may be found neceſſary, to refreſh, cheriſh, or reſtore the natural vigor. Patients, in a courſe of theſe waters, are apt to be drowſy and ſleepy. But, ſleep in the day time is not to be permitted, eſpecially after meals; as it obſtructs digeſtion and the excretions. And thereby lays a new foundation for the evils generally ſought to be removed or prevented; crudity and plenitude. Every perſon; uſing theſe waters, ſhould go to bed at a regular ſtated hour; ſooner or later, as more or leſs ſleep may be found neceſſary; and riſe at a certain ſtated hour the next morning, to return to the fountane of health, and the exerciſe of the functions of life.

§ 464. 5. The Diſcharges of the body are regulated by the courſe of the waters; after which, the next things to be conſidered are,

§ 465. 6. The Paſſions of the mind; theſe require the greateſt attention and care; ſince, without the ſtrictеſt regulation of them, the uſe of theſe and moſt other active waters, will be uſeleſs, if not prejudicial; as the irregular ſalies of inordinate paſſions overſet and diſtract the whole animal oeconomy. For this reaſon, all that have recourſe to theſe or theſe like waters, with hopes of ſucceſs, muſt diſſipate all care, diveſt themſelves of all attention to ſtudy or buſineſs whatſoever, and keep every paſſion under the guidance of reaſon,

reaſon, or as much as poſſible give up the whole mind to amuſements, and keep it in ſuch a ſtate of diſſipation. But, let all avoid the errors, which are generally run into at baths and other water drinking places; eſpecially, by thoſe of our country; I mean in ſtudying for pleaſures, or laying themſelves out with as much anxious ſolicitude for amuſements, as can be requiſite to carry on the buſineſs of any ordinary vocation. To this ſhameful exceſs, is the now great and important, but in wiſer days, reproachful and abominable, buſineſs of gaming carried on, almoſt univerſally; and what ſhould onely be uſed as a mere amuſement, made a ſerious occupation. I need not attempt to paint out the too obvious, ſhameful agitations of paſſions ſeen in moſt private, as well as public, aſſemblies upon theſe occaſions. It is enough for my purpoſe to warn men againſt ſuch, by letting them ſee, they are generally incompatible with the ſucceſs of theſe and moſt ſuch like waters, as they are with the dignity of rational minds.

§ 466. Next to this moſt ſordid paſſion, that, which does moſt honor to human nature, is apt, among the younger claſs, to prevale. It will be readily judged, I muſt mean love. What pity it is, ſo noble, ſo ſweet a paſſion, that, in which man moſt emulates the divinity, for, God is love; what pity, I ſay, it is, that this paſſion ſhould prove productive of any evil. But, ſuch is the caſe: It is here moſt injurious in the beſt acceptation of the word. How much more in the modern perverted meaning, in which it implies a paſſion, the illicit indulgence of which, levels the rational with the brutal mind. The gratification of luſt, to which theſe and all waters, that tend to the reſtoration of health and vigor, prompt, is carefully to be avoided; eſpecially, where onely a ſtimulus alone is given, and that but momentarily; ſince, after ſuch exerciſes, the bodies are found much more languid and imbecil, more unfit for amorous intercourſes, as well as other purpoſes, than before.

§ 467. It is the province of the phyſicians of the ſoul alone to urge a more complete and continual obſervance of the regulations of the paſſions, which diſtinguiſh the true believers from infidels, rational from irrational ſouls, and ſecure the eternal health of the better part, the ſpirit; while it be my taſk to point out thoſe things, that regard temporal health, chiefly that of the periſhable part, the body.

§ 468. It is vanely thought, that, as ſome men do corporal penance for their ſins and return with new apetites to their luſts; ſo, they may ſubmit to a ſtrict courſe of theſe waters, and obſerve a moſt exact regulation of all the Non-naturals here, for a while; hoping to be able to return to the gratification of all their apetites, with new reliſh and powers. Let ſuch but think, and be undeceived. Is the glutton the more ſecure or the better for having emptied his inſatiable ſtomach, with a vomit, to prepare for new exceſs at a banquet? Or, is the ſwine to be conſidered as clean, who after waſhing, ſtraitway returns to wallow again in it's favorite mire? —The perſon, who by a courſe of theſe or any other medicated water, or other medicine whatſoever, under the moſt juſt regulations, recovers health; ſhould, by the temperate uſe of the goods of life and the moderation of apetites and paſſions, learn to hold the ground, he has gained; to preſerve health, which the longer or oftener it is interrupted or loſſed, the more ſlowly and hardly it can be reſtored or recovered. It is found by fatal experience, that where the waters ſuccede beſt, ſuch patients, as do not, at leſt for ſome time, purſue the regular courſe of diet, &c. obſerved with the waters, ſuddenly relapſe into their former, or perhaps fall into worſe, diſeaſes. Of which, they often inconſiderately impute the blame to the waters.

XV. *Of the external uſe of the Baths of* AKEN.

From pure regard to great eminence,
In the moſt uſeful branch of Phyſic;
From the moſt tender reſpect and affection
To a well-proved Friendſhip;
Preſented
To
Mr. ADAIR, Chirurgeon,
of LONDON.

§ 469. AS it muſt be neceſſary to recapitulate what has been ſayed of ſimple, warm water, in judging of the effects of medicated hot water; ſo we muſt recur to what has been ſayed of ſimple, to form a judgment of the medicated, baths.

§ 470. Whatever then is juſtly attributed to warm baths or the vapor or ſteam of hot water in general, muſt hold good, in an eſpecial manner, of water impregnated with ſuch principles, as increaſe it's ſoftening, relaxing, penetrating, reſolvent and deterſive qualities; ſuch as have already been demonſtrated in theſe excellent waters.

§ 471. The great convenience and elegance of the baths of Aken, preferable to any we ſee or hear of elſe where, have been ſet forth at large in the begining of this diſſertation. Nothing here remanes, but to explane the uſes of theſe waters in the way of baths, which may be looked upon as threefold, the general, the partial and the vapor bath, of each of which a word or two a part; as little more is neceſſary, after what has already been ſayed on ſimple warm baths.

§ 472. But, though GALEN ſeems to prefer ſimple potable water, to that of the ſea or other ſalt, nitrous, or

or ſulphureous waters in baths, eſpecially in tertian fevers[a]; yet, the baths of Aken will be found, from their ingredients, to be more effectual in many inveterate caſes, than baths of mere ſimple water can poſſibly be.

§ 473. As the internal uſe of this or any other water is onely to be determined by experiments demonſtrating the proportions, properties and qualities of the ingredients; ſo is the external uſe to be aſcertained upon the ſame principles ſolely.

§ 474. Hence, it will appear, that whatever ſimple warm baths may, theſe muſt, effect; and on the other hand, that theſe, by their ſubtil, active conſtituent parts, may produce effects, which ſimple baths can not.

§ 475. To be more explicite; does a ſimple bath ſoften and relax the ſolids, rarefy and dilute the fluids, cleanſe and open the pores?— Theſe medicated baths muſt do the ſame more powerfully, from the action of the warm water, which is their baſis, with the addition of it's volatile mineral ſpirit and inflammable principle, together with it's reſolvent and deterſive ſalts. Therefore, more previous preparation becomes neceſſary, more care and caution is to be had in adminiſtering theſe, than ſimple warm baths.

§ 476. They are to be uſed at the ſame ſeaſons of the year and times of the day, with the ſimple baths; that is in the warmer, rather than the colder, months; and either morning or evening, as ſuits beſt the occaſion or emergencies of the patient; taking care the bowels be always empty and free; for which purpoſe, the internal uſe of the waters proves the beſt preparatory.

§ 477. The time of ſtaying in the bath is to be determined onely from the caſe and circumſtances of the patient. The more aged, robuſt, corpulent, and full, bear and require bathing the longeſt. The more young,

[a] Lib. i. Art. curativ. ad Glaucon.

de-

delicate, lean and emaciated, are ſerved with, and indeed bear, leſs. Neither ſhould ſtay in the bath longer, than they find their heads perfectly free and eaſy, their ſpirits and ſtrength refreſhed: For, as ſoon as the head begins to be heated, or feels full or heavy, or the patient grows languid or dull, he ſhould be directly removed from the bath and layed in a warm bed to cool gradually, or to ſweat; according to the preſcriber's intention. Uſe makes bathing more familiar, but then leſs efficacious, to all.

§ 478. For moſt purpoſes, it is ſufficient to bath from fiveteen to thirty or forty minutes; though ſome bear up to ſivety or ſixty; none can well require more. In moſt caſes, this bath becomes the moſt powerful and certain ſudorific known; eſpecially, when this intention is ſeconded by drinking ſome glaſſes of the water in the bath or ſoon after going into bed. Where ſweating is not in view, and the relaxing the fibres and inviting the humours externally is deſired; there, a glaſs or two of cold water, occaſionally mixed with a little wine, or ſome glaſſes of Spa water may be given to moderate the internal heat and ſupport the ſtrength. And thus, this chalybeate water, which in ſome dry, obſtructed, conſtipated habits of body, can not be taken with deſirable ſucceſs; may, by this manner of giving it for ſome time, prove moſt agreeable, ſafe and effectual.

§ 479. It is not eaſy to determine how often the bathing ſhould be repeted. That, as well as the length of the time of continuing in the bath, muſt depend upon the age, ſex, ſtrength, habit of body, and diſorder of the patient. In very robuſt perſons, of dry habits, and in obſtinate caſes, it may be repeted once, yea twice a day. In others, of a weak, moiſt and lax frame, it is not to be admitted above once in two, three, four, ſix or eight days: Upon all occaſions, in all caſes, ſtrictly attending to this; that it does not too much emaciate the body, or waſte the ſtrength, of the patient. This caution may be gathered

thered ſo early, as from the time of ARISTOTEL, who remarks [a] that warm baths relax hard and rigid fibres, and thereby render them more vigorous and agile; but totally unbracing the humid and lax, utterly debilitate them.

§ 480. The frequency of waſhing in the antient Roman baths, and their cuſtoms and manners, with reſpect to bathing, may be collected from SENECA [b], VITRUVIUS [c], BLONDUS [d], POLYDORUS [e], MERCURIALIS [f], ROSINUS [g], ALEXANDER [h]; as moſt matters known in his time, relating to the baths of Aken, may be found in the laborious BLONDEL, often before mentioned.

§ 481. The Romans at firſt, when their baths were as few, as their aparel was light and ſimple, contented themſelves with waſhing thoſe parts onely, that were expoſed to view, their limbs, every day; taking care to cleanſe their whole bodies, on all ſtated public aſſembly days, as markets, elections, &c.

§ 482. But, as ſoon as their conqueſts brought them in riches, and gave them a taſte of the luxuries of their vanquiſhed neighbours, they multiplied the number of their baths, and adorned them with the moſt ſumptuous elegance and magnificence; as we ſee them expoſed by CLEMENS ALEXANDRINUS [i], SENECA [k], STATTIUS [l], and MARTIAL [m]. Now, the uſe of bathing became very frequent; ſo that not onely the rich, who erected ſuperb baths for their own private uſes, after the time of Pompey, bathed their whole bodies every day; but the poor had them brought within their compaſs, by making the price of bathing in the public baths no more than a farthing, which tax we find ſometimes had been remitted by popular ſpirited men; as is recorded to the honor of Agrippa, by Roſinus, and of Antoninus Pius, by Mercurialis, in the books

[a] Sect. iii. Probl. q. 16. [b] Epiſt. 87. [c] L. v. c. 10. [d] Romae inſtaur. L. ii. [e] L. iii. c. 13. [f] Gymnaſt. l. i. c. 10. 11. [g] Antiq. Rom. l. i. c. 14. [h] Ab Alexand. Genial. l. iv. c. 20. [i] Paedagog. l. iii. c. 5. [k] Epiſt. 87. [l] Sylvar. l. i. [m] L. vi. epigr. 42.

before

before cited. This tax however was generally impoſed, except on children under ten years of age. Theſe obſervations illuſtrate, and are illuſtrated by, ſome paſſages in our Claſſics[a].

§ 483. Some repeted their bathings ſeveral times a day. The emperor Commodus accuſtomed himſelf to bathe ſeven times a day; but Gordianus and Gallianus reduced it to five times a day, in ſummer, and twice, in the winter. And, as great men were never known to want flatterers or followers, even in their follies and vices, in any age or nation of the world; and as the modes of a court, not onely generally have been found to give ſanction and authority to folly and vice, but even in time, to change it's complexion and character, in common eſtimation; there is no doubt, the Little, in Rome, as every where elſe, took all pains to emulate the Great; ſo that warm bathing was there at length carried to the ſhameful and deſtructive exceſs of other luxuries. Hence we find, that from the time of Pompey, to that of Conſtantine, the uſe of bathing was become ſo familiar, that all ranks of men ſeemed inclined to live in their baths; in which men and women ſupped promiſcuouſly; whileſt others never ſupped, till after bathing. Near, but not quite, to this exceſs, did Charlemagne carry that of his favorite baths at Aken, as we have taken occaſion before to mention.

§ 484. But, the modes, as well as times, of bathing varied greatly in Rome. Hadrian decreed, from noon to night to be the ſtated time of bathing. Afterwards, about eight at night was the hour alotted for it; and it was prohibited, by an imperial decree

[a] Martial. l. x. epigr. 60.

Balnea poſt decimam laſſo, centumque petuntur
Quadrantes———

Juvenal. Satyr. ii.

Nec pueri credunt, niſi qui nondum aere lavantur.

Ejuſd. Satyr. vi.

Caedere Sylvano porcum, quadrante lavari.

Horatii l. i. Satyr. 3.——dum tu quadrante lavatum
Rex ibis.

of

of the above Emperor, to all, but ſick, to bathe before that hour. After which, bathing, till morning was to all interdicted: Until Alexander Severus, deſireous of popularity, opened the baths for the accommodation or gratification of the populous, at night; furniſhing their lamps with oil, for their illumination.

§ 485. Thus far, I have ſketched out the civile, not the medicinal, uſe of baths among the antient Romans. Had they gone no farther, than the uſing them to cleanſe the body in general, the pores of the ſkin in particular, in thoſe days, when the modern wearing and frequent changing of linen was unknown; they had undoubtedly been elegant, as well as ſalutary; but, on the contrary, the exceſs, to which bathing was carried, appears to me to have greatly concurred, with other luxuries, to ſoften, enervate and corrupt a people, whoſe ſtrength and greatneſs of mind, at certain periods of their annals, were hardly ever equalled, but never outdone, by any other.

§ 486. But, let us ſee, what the philoſophic, the phyſical, world judged of baths in thoſe days, and by that, with the help of the new lights thrown upon the healing art, by the variety of diſcoveries and improvements therein, which we have lived to ſee; let us learn to ſteer the middle courſe between their too frequent uſe, I may ſay, their abuſe, and our too great neglect, or diſuſe of baths.

§ 487. I have already given ſome ſketches of the ſentiments of the antient philoſophers and phyſicians on this head. I ſhall here add a few more.

§ 488. VITRUVIUS [a] judges all hot water, not onely in itſelf medicated, but by heating capable of ſuch impregnation, as might give it new and extraordinary virtues. He was not unacquainted with the qualities of ſulphureous waters, to which he attributes that of relieving nervous diſorders; as he does that of

[a] Architect. l. viii. c. 3.

helping

helping paralytic complaints, to aluminous [a] waters, and that of correcting the vices of the juices, to the internal uſe of bituminous waters.

§ 489. No phyſician antient or modern has formed a more juſt judgement of the qualities of baths, than CLEMENS ALEXANDRINUS[b]. He expertly obſerves, that the frequent uſe of baths greatly relaxes, and thereby waſtes the natural ſtrength, and occaſions faintings and ſwoonings. He knew that animal bodies, as well as vegetables were endued with inſorbent pores, which ſome affect to look upon as a modern invention: For, he ſays, that human bodies take in liquids, not onely by the mouth, but as trees do, by the pores, and that during the time of bathing. In proof of which, he remarks that thirſty perſons have their thirſt ſlaked, by bathing, as well as drinking. And this is further evinced by a more modern trial, that of weighing a body before and after bathing; when upon compariſon, a conſiderable increaſe of weight is always found. This author ſpeaks moſt ſenſibly againſt the indiſcriminate uſe of bathing, and inculcates this moſt juſt caution; that it is always to be avoided in the extremes of inanition, as well as of repletion; and to be adminiſtered with attention to the age, and conſtitution of the patients and the ſeaſons of the year; as, by the moſt ſkilful, it is found not always to agree with, nor to be alike ſerviceable to, all.

§ 490. PLUTARCH looks upon natural baths as moſt powerful remedies[c]. And ſays, that variety of baths, of all things, works the greateſt change in human bodies, as ſuch is capable of producing new, as

[a] By aluminous waters, I ſuppoſe this grave author muſt have meaned ſome ſubacid ſprings, the acidulae, many of which are in our days reputed aluminous, without containing a particle of that minrral. As the Tonnelet at Spa, and the baths of Bordſcheit or Borſet near Aken.

[b] Paedagog. Lib. iii. c. 9.

[c] Opuſcul. de comparatione ignis et aquae.

well

well as removingthe old, diſorders, or of ſoftening the body, as iron is ſoftened or expanded by heat, and hardened or condenſed by cold [a]. The ſame author elſewhere, obſerves, that cold bathing, after exerciſe, carries with it more oſtentation, than of any thing really conducive to health. He judges, in this reſpect, it can onely ſerve to ſtrengthen the body and render it leſs obnoxious to external injuries. Whileſt he judges more favorably of the uſe of warm bathing; which, as he remarks, whileſt it tends to diminiſh the natural vigor and ſtrength, on the one hand, conduces to reſtoring them on the other; in as much, as it gently prepares the way to the concoctions, and refreſhes fatigued limbs [b].

§ 491. Celſus recommends general or partial warm bathing, with or without inunction with oil, in all caſes of great fatigue, or being over heated in travelling or working in the heat of the ſun; after which, he generally recommends immerſion in cold water [c]. And elſe where, he applies it in various fevers, before, in and after the fit, as before obſerved, in ſimple warm bathing.

§ 492. Whatever has been, or may be, reaſonably, ſayed of any bath, ever ſo much celebrated by the antients, may of a truth be applied to thoſe of Aken. Is a ſulphureous bath requiſite?—No water has ever been diſcovered, to us, more ſtrongly impregnated with the principles of ſulphur, than that of the baths of Aken, newly drawn. Is a nitrous water quite devoid of ſulphur deſired?—Aken water long expoſed to the air or heated again is none other; as our experiments have fully evinced; And Bordſcheit waters will appear to be the ſame. So that it is plane, that every intention of the antient or modern phyſicians muſt be anſwered by theſe baths; which are found, thus managed, to be ſulphureo-nitrous, or ſimply nitrous.

[a] Sympoſ. l. viii. q. 9. p. 738. [b] De Sanitat. tuend. p. 140.
[c] C. Celſ. de Re medic. l. i. c. 3. ibid. l: ii. c. 17.

§ 493.

§ 493. It will not then be found wonderful, with thoſe, who comprehend our analyſis, and can judge of the qualities of the ſeveral ingredients, of which our water appears to be compoſed, ſeparately or conjunctly conſidered; ſuch, I ſay, will not wonder, that Aken baths ſhould be found remarkably powerful in ſoftening and relaxing the fibres, cleanſing and opening the pores; and curing the itch, herpes and other cutaneous foulneſſes and erruptions; and promoting ſenſible or inſenſible tranſpiration; diluting and attenuating the humors; diſſolving viſcid coheſions; reſolving contractions, coſtipations and ſpaſms of the bowels; eaſing pains, cramps, contractions and rigidity of limbs or joints; in relieving confirmed palſies and paralitic imbecilities, univerſal or partial; even ſuch as affect the ſpeech and hearing; in giving eaſe and freedom in the rhumatiſm, the ſciatica, and other gouts; in diſperſing oedematous and anaſarcous tumors; in mollifying hardneſſes and conſtrictions of the lower bowels, the inteſtines, kidnies, bladder and womb, and reſtoring thereby the natural diſcharges, whereby they become eminently ſerviceable in hypochondriac and hyſteric affections; particularly, in relaxing uterine tenſions or conſtrictions, opening obſtructions and cleanſing it's exterior appendages, and thereby promoting conception. Theſe waters alſo make the moſt excellent fomentation and waſh for the eyes, where there are obſtructions in the ciliary glands or ſcorbutic humors fallen upon the membranes.

§ 494. But, though theſe baths are found extremely effectual in an almoſt infinite variety of diſorders; there is none, in which they are more remarkably beneficial, than in thoſe evils, that attend the ill-judged or ill-conducted uſe of quickſilver. No men are known more wretched, than ſome of the numbers, who, for ſcars in the wars of Venus, fall into the hands of any of the multitude of low and mercenary pretenders, that diſgrace our age and are now the peſt of

every nation: For, if thoſe unfortunate men ſhould get clear of the venereal diſtemper, for which they undergo the ſevere, unnatural courſe of ſalivation, which in ſuch hands is always doubtful and hazardous; they are often found maimed and decrepid with tumors, ſpaſms, contractions, or perhaps, are rendered paralytic or hypochondriac, for life. Here, the quack finds himſelf out of his element, and the patient finds himſelf robbed and undone.

§ 495. The principal relief, our country affords in ſuch caſes, is by plentiful and frequent ſimple, warm bathing; but nothing known is obſerved ſo powerful, in ſuch inſtances, as the medicated baths of Aken. Mercury introduced into the maſs of blood makes a longer ſojournment in the body, than is generally judged. In vane is it thought to be carried off by ſpitting, entirely; after the moſt complete ſalivations, the humors remane long affected by it; and if any bowel or the glandular ſyſtem has been greatly diſtreſſed or obſtructed during the courſe, or any bone has become carious or foul; there, a lodgement is generally made, which partly remanes for life, and partly, being ſometimes, by fevers and other accidents ſet in motion; is again circulated to the great annoyance of the oeconomy; which inceſſantly labors to get ſhut of the heavy grievance. For theſe diſtreſsful complaints, too often deemed incurable, and often by bad treatment actually rendered ſuch; the baths of Aken are found the moſt ſovereign, I might have ſayed, the onely, remedy. They have hardly ever been known to fail of doing eminent ſervices, or perfecting the cure, in theſe deſperate caſes. If the mercury be lodged in any of the debilitated ſoft parts of the body, as in the obſtructed or otherwiſe vitiated bowels, muſcles or glands; it is brought again into motion by the help of the baths, humid or dry; that is, the common or the vapor bath, and caſt off by the pores of the ſkin; and there have been inſtances of it's having been in like manner, drawn

in ſome meaſure even from lodgements in or upon the bones; as by the abatements of pain, ſwelling and other ſymptoms, has appeared, by the ſame means.

§ 496. Theſe patients, months, and even years, after the profuſe application of the mercury, ſoon after having recourſe to the baths, find the ſame taſte in their mouths, as when they had newly taken that mineral; and ſometimes, they have been known to ſalivate, and that with greater eaſe and freedom, than they could have been made to ſpit in the mercurial courſe. Then, they are to have longer and more frequent recourſe to the baths, chiefly the vapor bath, ſo as to ſweat profuſely, as their ſtrength and other circumſtances admit. Some of the practicioners of Aken affirm, that ſome of theſe patients have been known to paſs off the mercury by the pores, ſo as to appear in globules in their beds. But, for this, I can not vouch, as none inſtance of it yet fell under mine obſervation.

§ 497. The manner of accounting for thoſe extraordinary effects of the baths of Aken, I take to be this; though mercury has ſometimes been diſcovered upon diſſections, not onely in the diploe or cellules of the bones, but in the vitiated ſoft or fleſhy parts[a]: Yet, I apprehend, it is not always to be ſought or found in that form; but, that it ſometimes ſuffers a kind of diſſolution in the humors, and thereby, as the functions of the parts are vitiated or loſſed, becomes inactive or immobile, and ſo remanes a liſtleſs and deſtructive burden to the broken oeconomy, ſtirring up hypochondriac or paralytic complaints, hectic fevers, &c. In the firſt caſe, it is not difficult to conceive how a warm, ſubtil, penetrating bath ſhould liquefy the juices, promote a free circulation in thoſe parts, in which it was before extremely languid, and cauſe a

[a] See MEAD's Eſſay on Poiſons. BOERHAAVE in Praefat. Aloyſ. Luiſini Aphrodiſm. LANGIUS, in Epiſtol. lib. i. epiſt. 43. FERNELIUS, de luis. venerae curatione, Aſtruc de morbis venereis, &c.

rarefaction, reſorption, and the expulſion of the before ſtagnated mercury. In the other caſe, nothing can be more likely to revive the diſſolved mercury, and reſtore it to it's priſtine fluidity and mobility, than the alcali and the phlogiſton, with which theſe baths abound. And thus in either caſe, they are well qualified to remedy the diſtreſsful diſeaſe.

§ 498. In thoſe diſorders of the joints or limbs, in which the bath is found ſerviceable, particularly rigidity, contractions of the joints and indolent tumors, the water will be rendered more efficacious by the pump; in which, a ſucceſſion of new water, hot and impregnated, falls conſtantly on the afflicted member, in a ſmart ſtream; which, by it's friction of the part greatly contributes to the cure.

§ 499. From what has been already ſayed of the vapor of ſimple water, this vapor bath may be eaſily judged more effectual in moſt caſes, than the humid bath, or the ſteam of ſimple water. Nothing can be more ſubtil and penetrating, than the volatile principles demonſtrated by experiments in the vapor of the waters of Aken. Reaſon then and experience authoriſe the uſe of this ſubtil vapor in the ſudatories, or vapor baths of this city; in which, it is found moſt warming, penetrating, attenuent, reſolvent and diaphoretic.

§ 500. Theſe baths are ſo conſtructed, and accommodated, that the vapor may be applied to any particular limb, or part of the body, or to the whole, in any quantity or direction, and of any temperature, required. In moſt caſes, where the humid baths are found uſeful, the vapor bath is found moſt uſeful. This penetrates more powerfully, without relaxing ſo much.

§ 501. The ſame general preparation and courſe of diet is neceſſary for a courſe of the one, as for that of the other. The ſame cautions to be obſerved. But, as this is more powerful in it's operation and effects, than that; few or none can require, or indeed

deed bear, the repetition or ſtaying the ſame length of time in the one, as in the other.

§ 502. As the vapor of theſe waters is apt to affect the head upon going into any of the humid baths, eſpecially when newly drawn; ſo is the head moſt apt to be affected by the vapor bath. From five to fiveteen or twenty minute's ſtay in this bath ſuffices in moſt caſes, repeted once in two, three or four days, according to it's effects and the ſtrength and circumſtances of the patient. But, the inſtant the face fluſhes and the head feels ever ſo little heavy or full, the patient is to be inſtantly removed to a warm bed in an adjoining room, where he may ſafely and conveniently encourage the ſupervening ſweat, and remane, till he becomes gradually cool. Then, returning to his lodgings, he is to be more ſtrictly careful in avoiding cold; which, after this, is more eaſily caught and more dangerous, than after the humid bath. Such arid habits and coſtipated or obſtructed pores, as do not eaſily diſcharge their contents by ſweat, ſhould be waſhed and rubbed in the humid, before they be committed to the vapor, bath.

§ 503. I ſhall conclude what I have to offer under this head with a few remarks, that may not be judged uſeleſs or foregne.

§ 504. As the internal uſe of the waters of Aken is not to be looked upon as of infallible or univerſal efficacy; no more are it's baths: When they are indiſcriminately uſed beyond the reſtrictions and cautions to be obſerved in the uſe of baths in general, warm baths in particular, more miſchief than real benefit is always likely to acrue.

§ 505. I heartily wiſh I could with truth ſay of other baths, what is obſervable of thoſe of Aken; that the promiſcuous bathing of ſexes is there abſolutely prohibited, for ſundry wiſe reaſons, which though moſtly obvious, I think neceſſary further to explane.

§ 506. All moral men looked with deteſtation on the promiſcuous bathing of ſexes, which became one of the prevaling vices of Rome, when that once great people began to fall into effeminacy, luxury and attendant ſlavery. Who knows not, that the ſight of a fair woman in a bath prompted a goodly king to foul concupiſcence, adultery and murder?—And, to what grave, ſanctified elders were tempted, by the ſight of a beautiful woman in a bath? Is every propenſity, every alurement or incentive to venery to be as much as poſſible prevented in a courſe of theſe and ſuch like waters? And ſhall provocatives to that paſſion be preſented to the patient's eyes, at the very inſtant of applying them? Are not the eyes the guides in love? And are they not firſt captivated in the combats of Venus, as well as of Mars?—Who can anſwer to theſe in the negative?—Not the moſt profligate and deſigning debauchee. It may be objected, that theſe are dull, cynical quaeres, not at all ſuited to our times or climes; where, when men and women do bathe together, they are all over cloathed and no where naked. Agreed; but theſe quaeres are nevertheleſs founded in truth, decency and phyſical reaſoning.—It is no where more neceſſary to avoid a familiar, intimate intercourſe with the ſex, than at Aken and ſuch like medicated waters or baths. Slight cloathing is next to nakedneſs, and every kind of covering obſtructs the operation of the baths, more or leſs; as has been often before obſerved. It is in general prudent to ſet a guard againſt every means of raiſing laſcivious thoughts. It is in an eſpecial manner ſo, where the nature of the courſe itſelf proves an incentive, and the conſequence is immoral, as well as, in a phyſical ſenſe, deſtructive. Bathing is beſt performed, where every part of the bath may ſucceſſively come into contact with the patient's body, and where friction, univerſal or partial, may occaſionally be interpoſed. This then can onely be where the body is actually naked: And therefore, for elegance, as well

as

as efficacy, every perſon ſhould have a bath to himſelf and his attendant, who alone ſhould ſee him naked.

§ 507. But, if theſe reaſons ſhould not prevale, as they may not, where, by length of time, men have grown, as they generally do, obſtinate and tenacious of the worſt founded opinions; let the judgment of the judicious MERCURIALIS be taken. He cites [a], the ſentiment of HESIOD, that no man ſhould enter a bath with a woman, or waſh in a woman's bath; and ſays, that among the antient Greeks, in the earlieſt ages, baths for women, quite ſeparate and diſtinct from thoſe for men, were appointed; in which men were poſſitively prohibited to waſh, whether there were women in them, at the time, or not. For the reaſons of which, let the ſage himſelf be conſulted.

§ 508. Theſe, with other obvious reaſons, which at preſent, with us, ſeem quite layed aſide, have induced the practicioners in Aken to introduce, and, with the concurrence of the magiſtrates, to eſtabliſh, the more elegant and rational practice: For, there, every perſon may have a ſolitary bath of any kind, at any hour; and no man is permitted to go into a bath, in which there is a woman; much leſs do women attempt to go into baths with men.

§ 509. Some practicioners, after an external, as well as internal uſe, of theſe waters, recommend repeted purgings with ſharp, and draſtic purgatives. But, it is a moſt ill grounded and irrational practice, founded on a moſt ridiculous notion, that the waters may leave ſome recrements, neceſſary to be purged off, or induce ſuch a ſtate of the humors, as may require this evacuation. This is too abſurd to demand an anſwer. He muſt be a weak practicioner, who ſuffers a patient to take a remedy for the cure of one diſorder, till it brings on another. Few or no vigorous conſtitutions require any aſſiſtance after a proper

[a] Gymnaſtic. lib I. c. 10.
Neque in muliebri balneo corpus abluito, vir.

courſe of theſe waters internally. Where any thing is wanting, it muſt be an invigorating, tonic medicine; ſuch as warm and reſtringent bitters, or Spa, or ſuch like ferrugeneous waters. The ſame may be ſayed after the external courſe; where theſe, with or without the uſe of cold bathing, can hardly fail of completing the cure. And there can not be a better, cold, pure, ſimple Bath, than Seffen water, before mentioned, affords.

The End of the ESSAY upon AKEN WATERS.

SECTION

SECTION IV.

Of BORDSCHEIT, *or* BORSET, *and it's Baths.*

From the moſt profound Eſteem and Veneration
For the MOST EXQUISITE ACCOMPLISHMENTS,
For GRACE, VIRTUE and WIT,
And for TRUE NOBILITY;
From a juſt Senſe of Gratitude
To the moſt honored, moſt munificent
Of his PATRONESSES,
Upon the Continent,
This Eſſay is moſt humbly inſcribed
To
Her EXCELLENCY
The COUNTESS of PLETTEMBERG WITTIM,
By Birth,
PRINCESS of LAMBERG.

§ 1. FROM Aken and it's baths, to Borſet and it's neighbouring and nearly allied ſources of hot waters, the tranſition is eaſy and familiar.

§ 2. Few write the name of this place alike, though moſt ſeem agreed in it's etymology. The Germans generally write it Bordſcheit, Burdſcheit or Burtſcheit, the French Borſet, and ſuch as write in Latin call it Porcetum. I take the German name, Burdſcheit, to be a compound of two words in that language, the firſt ſignifying a burden, the other a billet of wood; as if one ſhould ſay, the load of faggots ot billets; from it's having been, as is confeſſed, a thicket of wood, that ſome time chiefly ſupplied the neighbouring

ing city with ſuch fewel. Others think the name Porcetum, of which the French ſeems a corruption, more regarding the ſound than ſenſe of the word, to have obtained from this place, whileſt wooded, being the reſort of great numbers of wild ſwine. But, this, as but of little import to a phyſical diſſertation, we ſhall quit; and taking any name, by which it is generally known, purſue our more uſeful enquiries.

§ 3. Borſet is a little valley within leſs than a quarter of a mile of the ſouth of Aken, reckoning from the gate, that leads thither. It is compoſed by two ridges of little, but ſteep hills. It is now a conſiderable village, with a convent of nuns and a church. The principal ſtreet is built from the top of the higher hill, down a precipice to the bottom of the valley; where there are a great many good houſes, irregularly built, and chiefly for the uſes and accommodations of the baths. The greateſt number of it's inhabitants are cloath-workers, who are induced to come there by the plenty of hot and lixivial water, which the baths afford, ſo uſeful in their manufacture.

§ 4. This is an independent Seigneury, which once belonged to a private gentleman; who ſold it to a convent, whoſe abbeſſe is now ſovereign there; but, ſhe commits the adminiſtration of civil government to one of the burgomaſters of Aken, who is ſtiled her Adminiſtrator or Mayor of Borſet.

§ 5. Along the valley, in which Borſet ſtands, there runs a conſiderable ſtream of mountane water, which feeds a large pond belonging to the convent and turns a fulling mill in the town.

§ 6. There are two different kinds of thermal water at Borſet; which we ſhall diſtinguiſh by the ſuperior and inferior, or upper and lower hot ſprings. The firſt or ſuperior baths ſpring through the fiſſures of gritty rocks, in different places at the foot of the greateſt hill, and united, make a very conſiderable ſtream, ſuch as turns the wheel of a large over-ſhot mill. In the middle of the flat ſtreet, there is a large

baſon

baſon of ſeven or eight feet in diameter, and three or four feet deep, environed with a parapet wall and a palliſade gate. In this, the water ſprings up as clear as cryſtal, with the appearance and bubbling noiſe of a large boiling caldron. From this and various other ſources of the ſame kind of water, which ſpring from the foot of the hill next to Aken, a great number of baths are furniſhed in the town.

§ 7. The ſecond or inferior baths ſpring in different parts of the lower ridge of the little hills that compoſe the valley, on the furtheſt ſide from Aken, towards the caſtle of Frankenberg. Of theſe, there are ſeveral in different places at the foot of the riſing ground; the moſt conſiderable of which is not above three hundred yards from the hot ſprings in the village; near the ſtream of waſte water, that runs from the baths, and fills a large pond a little lower, which ſerves for a fiſh pond, as well as a mill-dam. Theſe waters are very different. Thoſe, which ſpring on one ſide of the valley, the inferior, for example, are ſulphureous, thoſe on the other, the ſuperior, are not.

§ 8. Nothing but the proximity of Borſet to the moſt famous waters in Europe could leſſen their value: Were they at any conſiderable diſtance, they muſt undoubtedly be, as they juſtly deſerve, moſt highly prized. Of this, we ſhall be better convinced, by taking the ſame analytical view of theſe waters, as of thoſe of Aken. I ſhall begin with that, which bears the greateſt analogy to theſe, and then procede to the other.

I. *Of the lower hot ſprings of* BORSET.

Preſented
To his ingenuous Fellow-laborer,
Collegue and Friend,
THOMAS LE SOINNE, M. D.
Author of an inaugural Diſſertation on the
Baths of AKEN and BORDSCHEIT.

§ 9. THESE ſprings iſſue from the weſt ſide of a low, green fertile, though rude and uncultivated, hill; through a gravelly and loamy ſoil.

§ 10. At what time, or by what accident, theſe were diſcovered, none account can now be gathered. Being ſo near the great baths of Aken, they have been but little regarded. Like thoſe however, I apprehend theſe were firſt found, by the ſmell, which is however not ſo ſtrong as that of thoſe of Aken; whence, they have been generally looked upon, by thoſe, that truſt to their ſenſible qualities onely, as quite void of ſulphur; which is notwithſtanding a miſtake, as we ſhall preſently demonſtrate by experiments.

§ 11. I ſhall here, as at Aken, confine myſelf to the principal ſource, that which is the hotter water, as well as the ſtronger impregnation; the ſpring next the village. This iſſues from the foot of a little precipice, where a wooden pipe has been layed, whoſe bore is of about two inches in diameter; of which the little ſtream hardly occupies one third.

§ 12. Wherever this ſpring in it's current touches the wood, or the lower ones ouze from the ſoil, theſe places are covered over with a white, ſoft, ſilky hoar, which ſome have taken for ſulphur: But, upon a cloſer examination, I find it to anſwer the deſcription

tion of RAY's fineſt and ſmalleſt crow-ſilk [a]; I found it of all colors; but in the ſtreams of theſe thermal waters, it appears generally white. This might well, as it does with ſome, paſs for ſulphur; for, being dried and thrown upon an ignited iron, it catches fire, emits a blew flame and an intolerable acid vapor; after which the little filaments of the plant take fire and burn in their proper manner. So that it is evidently, no more than this minute vegetable, incruſted with ſome particles of fine, ſubtil ſulphur.

§ 13. Notwithſtanding this, the water is generally deemed void of ſulphur; though it's ſmell and products indicate the contrary; and though the ſediment depoſited in the ſtream be black, like that of the waters of Aken. Moreover,

§ 14. 1. It ſmells and taſtes like the thermal water at the fountane of Aken; but ſomewhat leſs offenſive. And as I had occaſion to viſit it very often early in the morning, before any body elſe had been there; I ſometimes found diſtinct flakes of the ſame kind of ſulphur, I gathered on the vaults of the ſources at Aken, that had newly dropped from the pipe, and layen under it in the well. I found and gathered there, one morning, three drachms of very perfect, pure ſulphur. Whence, I conclude, that ſulphur is generated and formed in this ſource, as at Aken; and that increaſing, till it comes within the reach of, or falls into, the courſe of the water; it is at length thus waſhed away by the current and diſcharged.

§ 15. 2. In color and tranſparency, it equals, if not excedes the waters of Aken. Though it is by no means free from ſuch little, light flocculi as are found aflote in that. And like that, upon ſtanding grows ſomewhat turbid and lets fall a terrene precipitate; whileſt, in like manner, it loſes it's offenſive ſmell alſo. Which ſmell may again be in part reſtored at firſt heating, but at length totally deſtroyed.

[a] Conferva gelatinoſa omnium tenerrima et minima, aquarum limo innaſcens. Synopſ. edit. iii. tom. ii. p. 477.

§ 16.

§ 16. 3. It's heat excedes that of the hoteſt of the ſuburbian baths of Aken. It raiſes the quick ſilver in Wilkins's ſmall thermometer about four degrees above the higheſt number on the ſcale, which is 120. In Prins's double-tubed thermometer, to 31. In Fahrenheit's to 132. that is within two degrees of the New bath at Aken.

§ 17. 4. The ſame phial, in which the other waters were weighed, filled with this water of the natural heat, weighed five ounces, one ſcruple and eighteen grains; with the ſame cold five ounces, two ſcruples and ſix granes and an half.

§ 18. 5. This water waſhes and cleanſes, as well as the waters of Aken, and ſerves a like for the boiling eſculent vegetables, &c.

§ 19. 6. A piece of ſilver ſet in a glaſs of the water newly drawn, gets but a very ſlight tinge in ſeveral minutes; but, thrown where a continual current of the running water ſtrikes it, in leſs than a minute, it becomes deeply tarniſhed all over with ſeveral different ſhades of yellow, orange, red, blue and purple.

§ 20. 7. With the powder and infuſion of galls, the like effects as at Aken; but leſs muddy and leſs upon the green.

§ 21. 8. Rhubarb in powder and infuſion, gave the like appearances, as in Aken; rather paler colored.

§ 22. 9. Red roſes, dried, and in infuſion, wrought the ſame changes, as in Aken; rather paler.

§ 23. 10. Paper dyed with the juice of tournſol, yields it's dye to this water, as at Aken; but, ſhews more of the roſe, than the violet in the purple color. It likewiſe recovers ſpots made with the lighter acids in the color of the blue paper; but, not ſo readily, as at Aken; and ſoon after diſcharges all the color of the paper.

§ 24. 11. With ſirup of violets, no change at mixture, but dilution and a ſeeming diſcharge of color;

lor; but, in about a minute, it turns to a pale, ſea green, which improves in an hour to a bright pale graſs-green. And in about twelve hours, fades to a ſad yellowiſh, ſeemingly void of any tincture of the green color.

§ 25. 12. This ſirup in the ſame manner mixed with the water evaporated, to the abſumption of a ſixth part, inſtantly turns to a beautiful, bright green, as at Aken.

§ 26. 13. With campechy log-wood, this water produces the ſame effect, with thoſe of Aken.

§ 27. 14. With cochinelle, the ſame color is produced, as at Aken; ſeemingly paler for a long time.

§ 28. 15. Fixed and volatile alcalies, liquid and concrete, produce effects in this, analogous to thoſe in Aken waters; but, with the later an ebullition ſeemingly greater.

§ 29. 16. The ſtrong and the diluted acids of vitriol produce a ſenſible ebullition, and alike preſerve or reſtore the pellucidity of this, as of Aken water.

§ 30. 17. The other mineral acids, that of nitre and that of ſalt, produce the like effects, as at Aken.

§ 31. 18. The vegetable acids, whether ſimple, deſtilled or fermented, all produce the like effects in this, as in Aken water. And particularly,

§ 32. 19. The like ebullition and the ſame changes of color ariſe upon the inſtilling deſtilled vinegar into this, as into Aken waters; but, it requires more of the acid to produce the like effect, and the color does not remane ſo long; for, in this, it almoſt diſappears in about twelve hours. And in this water cold, no viſible commotion, milkineſs or other change of color, appears. In the ſame evaporated, the like effects, as in Aken waters, are produced.

§ 33. 20. The neuter ſalts, with mineral acids, cauſe no more change upon mixture with this, than with the water of Aken; except,

§ 34. 21. Salt ammoniac, which is decompoſed with this water, as with that of Aken, evaporated.

§ 35.

§ 35. 22. The ſolution of alum mixes with this water without any ebullition, or appearance of air bubbles; yet, cauſes the ſame milky clouds, coagulation, and precipitation, as at Aken.

§ 36. 23. The ſolutions of mercury in the acid of nitre, anſwer ſo nearly to the effects they produce in Aken water, that they are hardly to be diſtinguiſhed.

§ 37. 24. The ſolution of corroſive ſublimate cauſes the like changes in this, as in Aken water.

§ 38. 25. The ſolution of ſilver produces the ſame coagulation, inteſtine motion, and precipitation, as in Aken water; but all much paler colored.

§ 39. 26. The ſolution of lead cauſes the ſame coagulation and precipitation; but, of a much paler color.

§ 40. 27. It decompoſes the ſolutions of the two vitriols, in the ſame manner as the waters of Aken.

§. 41. 28. Expoſed to the air, till it cools, this water, like that of Aken, ſuffers a loſs of it's acid and phlogiſton; amits of it's pellucidity; inclines to be turbid; throws up a light, ſoft, terrene, aſh-colored pellicule to the ſurface and to the ſides of the glaſs, part of which ſubſides. This, in all reſpects, agrees with the like pellicule and ſediment of the Aken waters.

§ 42. 29. Committed to evaporation, it ſooner loſes it's volatile parts; grows ſooner and more turbid and milky; and throws up a thicker pellicule and lets fall an heavier ſediment, in a ſhorter time than in the open air alone. After being once heated, to the degree of boiling, it ſhews itſelf upon all trials alcaline and void of phlogiſton; by changing ſirup of violets inſtantly green, and giving fair colorleſs precipitations with ſilver, lead, &c.

§ 43. 30. In evaporation, the terrene is ſucceded by a clear ſaline pellicule, towards the abſumption of the humidity, with all the other appearances attending the evaporation of Aken water to dryneſs. Thirty

five ounces exhaled leave a ſalt-like ſediment, weighing one drachm and eight granes.

§ 44. 31. One drachm of this maſs waſhed with diſtilled water, ſeveral times, leaves of inſoluble, pale, aſh colored matter, four granes. This cauſes an ebullition with acids, partly diſſolves in them, and by calcination, becomes lime. Whence, it may be looked upon as the ſame kind of earth with that of Aken waters.

§ 45. 32. The waſhings of the remaning maſs, filtrated and evaporated to dryneſs, yield a fair, colorleſs ſalt, anſwering all the characteriſtics of that of Aken water.

§ 46. From theſe experiments and obſervations, it appears, that this is a water conſiſting of the ſame principles with thoſe of Aken; differing, though not very materially, from them in the proportion of ſome of the ingredients. This, for inſtance, is hotter than any water at Aken, except that of the great ſource; § 16. 3. It is lighter than any of the reſt for that cauſe; § 17. 4. It contains the ſame volatile principles, the acid and phlogiſton, as the Aken waters, and yields ſulphur as they do; § 14. 1. but, more of the acid; § 23. 10. § 24. 11. § 28. 15. And leſs of the phlogiſton; § 14. 1. § 19. 6. § 32. 19. § 38. 25. § 39. 26. They alike contain an abſorbent, calcarious earth, with ſome ſmall portion of ſelenite; of which there is about half a grane more in two drachms of the ſolid contents of this, than in the like quantity of Aken water; § 41. 28. § 42. 29. § 43. 30. § 44. 31. It contains alike a lixivial and a muriatic ſalt, of the ſame qualities, with that of Aken; but half a grane leſs in two drachms of the ſolid contents; § 18. 5. § 24. 11. § 25. 12. § 29. 16. § 30. 17. § 31. 18. § 34. 21. § 45. 32. As alſo, § 20. 7. § 21. 8. § 22. 9. § 26. 13. § 27. 14. which alſo prove, that this contains no more iron, than that.

§ 47. Hence, we may reaſonably conclude, that this water is poſſeſſed of the virtues of Aken water from the ſame principles, in an inferior degree. Any

where, but ſo near Aken, theſe waters would prove invaluable; but, their value muſt fall, in the vicinity of ſuch, as are found in moſt inſtances preferable. However, where leſs of the inflammable principle, and more of the acid may be deſirable, as in ſome very thin, hot, and bilious habits, theſe may make an agreeable variety, and ſhould ſometimes take place of the city waters.

§ 48. It is a pity, this curious fountane is ſo neglected, that there is not at preſent the leſt accommodation for either the internal or external uſe of it. As it ſeems a medium between the Aken and the upper Borſet waters; to the examen of which laſt, we next procede.

II. *Of*

II. *Of the upper hot ſprings of* BORSET.

With all due Reſpect and Humility,
Preſented
To that truly noble and valliant
Philoſopher and Hero,
The COUNT DE ST. GERMAIN,
Who favored the Author with his Countenance
and Attention to the Experiments on the
Baths of AKEN and BORSET, and
honored him with many marks
of his Friendſhip.

§ 49. THERE is an endleſs variety of theſe hot ſprings, which differ not ſo much as thoſe of Aken from each other. Heat is the principal quality, in which they are found different, and in proportion as that is loſſed, the quantity of terrene parts is diminiſhed. As then, the difference appears thus accidental, not eſſential, it muſt ſuffice to relate the chief obſervations and experiments made at the principal ſource and baths; which are the baſon in the great ſtreet, near the mill, and it's adjoining pump; and the baths at the ſign of the Cray-fiſh; which are nearly contiguous, and, in all appearances and qualities, agree.

§ 50. 1. This water appears at firſt ſight exceding bright and pellucid; but, upon a cloſer view, ſeveral little light ſhreds or flocculi are found a-flote in it, as in the other thermal waters. It is perfectly colorleſs; has no ſenſible ſmell; and gives a ſaline, ſomewhat bitteriſh and lixivial taſte.

§ 51. 2. It's heat, in the great ſource and pump, is ſuch as ſerves to ſcald pigs, chickens, &c. conſequently intollerable. In WATKINS's ſmall thermometer it raiſed the mercury inſtantly to the utmoſt extent of

the tube; in PRINS's double-tubed thermometer, to thirty four; three degrees higher than the lower fountane raiſed it. In the little ſource in the Cray-fiſh, the ſame degrees of heat are found. In FAHRENHEIT's thermometer, the mercury is raiſed in the little ſource in the houſe to 144. In the vapor bath to 144. But, in the ſources or aqueducts, that fill the baths, it is raiſed from this degree, to that in which it is found at the great ſource or baſon and the pump, which is 152; that is, ſixteen degrees hotter than the Emperor's bath, the hotteſt at Aken. This excedes the heat of any natural bath, I have yet ſeen or heared of. Nor have I found any material variation upon various trials in different changes of weather, from June to October.

§ 52. 3. In the ſame phial and ſcales uſed at Aken and the lower hot fountane, the phial full, of the natural heat, weighed five ounces, one ſcruple, and ſixteen granes; that is, two granes leſs than the lower fountane, and one grane lighter than the hotteſt at Aken. The ſame phial, full of cold, weighed five ounces, two ſcruples, and eight granes.

§ 53. Theſe two experiments agree in ſhewing this water hotter, and of courſe lighter, than that of any ſource in Aken. But, when cold, the degree of impregnation appears to be much the ſame.

§ 54. 4. The common uſes, to which theſe waters are applied, give the planeſt indication of their qualities. The inhabitants of the village are chiefly cloath workers; who are induced to come here, as the moſt commodious place for their manufacture; on account of the plenty of hot water fit to ſcour and cleanſe their wool and cloaths. Had the waters been hard, their heat would avale them but little; but, they are found lixivial, as well as hot enough, at ſome diſtance from the ſprings, to ſerve the purpoſes of theſe artiſans, as well as that of waſhing of floors and all manner of utenſils and likewiſe linen; for which it would not anſwer, had it been impregnated with iron, as BERGER ſeems to have imagined; for, then it muſt have dyed

or iron-molded the linen, as our country folk expreſs it; as he found the Caroline baths do.

§ 55. 5. They are likewiſe uſed in the dreſſing of all their proviſions, that are boiled, in which they are found to anſwer extremely well; as they facilitate the boiling of animal and vegetable food, give them an agreeable tenderneſs, and preſerve the greenneſs of coleworts, and other greens, peas, common and kidney beans, &c.; which muſt be owing to a lixivial and muriatic ſalt.

§ 56. 6. The ſenſes can determine nothing volatile or odorous in theſe waters; whence, their baths are leſs offenſive, and in general more agreeable, than thoſe of Aken. But, yet it is far from being devoid of volatile parts; as will, from ſundry experiments and obſervations, be made manifeſt. And firſt, from the vapor, inſipid and inodorous as this appears, 1. it corrodes lead, rather more powerfully than the vapor of Aken waters; ſo that the ſtrong leaden covering of the aperture of their vapor baths, is conſtantly found covered with a black powder; ſo ſubtil as to be hardly waſhed off the fingers of thoſe, that handle it. The external ſurface of this corroſion, bears likewiſe the bright appearance of a new amalgama of lead, with a redundance of quick-ſilver. From which conſideration alone, it is not to be fully cleared of ſome ſubtil ſulphureous principle; at the ſame time, that it appears ſtrongly charged with a moſt ſubtil, penetrating, volatile acid. Such is the plentiful ſucceſſion of this acid-fraught vapor, that a leaden cover for the perforation does not endure quite two years; but is ſo waſted, as to become too little, and therefore unfit for it's office. 2. It corrodes iron, as the vapor of that at Aken does; with this difference, that as the waters in the city are not ſo hot as theſe, their acid ſtrikes every thing leſs diluted than theſe, that ſend forth a thicker ſteam, which is a more humid vapor, in which the acid muſt appear leſs ſtrong, being diluted. 3. Hence, though it deſtroys linnen, it

works it's effects more ſlowly, than that of Aken generally does; And, 4. though it ſaturates an alcalcine ſalt, with which linen rags are imbued, as at Aken, it is more ſlow in it's operation, and it is more difficult to keep the neuter ſalt, from the great quantity of humidity, that waſhes all away, without great care to attend it.

§ 57. 7. The vapor collected and condenſed in the ſame manner, as that at Aken, 1. In ſenſible qualities differs not from common water deſtilled; 2. Weighs the ſame; 3. With acids, it mixes without any perceptible commotion or other change; 4. With volatile and fixed alcalies diſſolved, it ſuffers no ſenſible alteration in ſmell or color; but with theſe, in a concrete or dry form, ſome ſmall ebullition; 5. Poured upon clean ſteel filings the action of ſolution, with little air bubbles upon the metal, ſpeedily commences; 6. With ſirup of violets, it preſently ſtrikes the ſame color, the blew paper gives in the inferior and ſuperior Borſet waters, a roſe purple; 7. A ſolution of corroſive ſublimate does not alter it ſenſibly; 8. The ſolution of ſilver cauſes a very ſlight, colorleſs milkineſs; And, 9. the ſolution of lead is turned to a milky opacity, and gives a fair white precipitate. All which are evident proofs of an acid of the ſulphureous or vitriolic kind, without any evidence of the inflammable principle, with which the waters of Aken abound. Hence, it is no wonder, that not a particule of ſulphur has ever been diſcovered generated about theſe ſources. The reaſon is obvious; there is not enough, if any, of the phlogiſton. Here, it is obſervable, how eſſentially different theſe waters are from thoſe of Aken, and thoſe of the inferior ſources here.

§ 58. 8. This water expoſed to the air, till it be perfectly cool, throws up a more conſiſtent pellicule, than Aken water. At the ſame time, it abates of it's pellucidity, coats the veſſel, at the ſurface of the water, and lets fall ſome looſe, pale earthy ſediment to the bottom. Yet, the depoſite, made all along the

the current of the waters, running from the baths, appears quite black. But, this may be owing to ſome foregne matters, from bodies waſhed in it, ſewers mixing with it, &c. For, that it contains nothing ſenſibly ſulphureous or phlogiſtic, appears, among other circumſtances, from neither the water nor it's vapor tarniſhing ſilver to any ſhade of yellow, in twenty four hours.

§ 59. 9. Where ever a ſource of this water is ſeen to run along the earth, it forms ſtony concretions of a very firm, hard conſiſtency, and of a figure compounded of that of the current of the water and that of the body incruſted. In ſome of the baths, it gives an even ſurface, but breaks laminated, like that of the waters of Aken. In running through a pipe, it forms a tubular incruſtation, and in ſome ſhort time, fills the whole ſpace of the perforation. Where it runs over the face of a ſmooth rock, wall, or piece of wood, it coats it ſmoothly; but, where a briſk, little ſtream trickles over rugged ſtones, or an uneven brick or ſtone wall, there it runs into an infinity of odd forms; I have found round and oval ſtones in cluſters, ſomewhat like bunches of grapes, moſtly of a dark creme color, and ſome with a rediſh or ochrous ſurface; All laminated and ſtriated or radiated, like the bezoar or calculous concretion in an animal body. The detached pieces are rarely ſeen without a kind of nucleus or kernel, on which they have been formed, like the ſtony conrcetions of animals. I have found an old birchen beſom, finely incruſted over with this petrification: the wood and even it's bark entirely ſound. I have alſo found rags, ſhreds and ſtrings included in ſuch petrifications, which induced me to conclude, it could not have layen long in the proceſs, by their incloſure's having ſuffered no decay, or ſenſible change. In this reſpect alſo, this water appears to differ excedingly from the waters of Aken, and to approach near to the quality of thoſe of Carol's badt in Bohemia; except in containing iron, of which, by every proper experiment, this appears quite free.

§ 60. 10. This water, by heating above it's natural degree, grows turbid and depoſites it's terrene parts, which may, by boiling and ſubſidence, be in a great meaſure ſeparated from the fluid element. In this operation, it gives another proof of it's containing an acid, the ſolvent of this earthy matter; as will further appear upon comparing the water in the natural ſtate, with the ſame evaporated, until it be ſpoiled of it's acid, and it's earth be partly precipitated, by evaporating about a ſixth of it's humidity. By evaporated water in the following experiments, this is to be underſtood.

§ 61. 11. The powder or the infuſion of galls works no ſenſibla change, but a ſlight mikineſs. This increaſes to a muddineſs and opacity, in about twelve hours. Without any tendency to a greenneſs, which the evaporated water, in leſs time, ſhews. This is demonſtration, 1. that there is none iron in this water; 2. that there is more of an acid in it, than in that of Aken, or the lower ſpring; and 3. that, when that acid is expelled in the evaporation, the alcaline ſalt becomes predominant.

§ 62. 12. With powder and infuſion of rhubarb, the like highthening of color, as at Aken and the lower fountane; but rather more ſlowly than either. With the evaporated water, a deep orange color is inſtantly produced.

§ 63. 13. Red roſes dried, infuſed in this water, in ſome three or four minutes, give ſome degree of light green. In twelve hours, it appears a deep amber color. The infuſion of red roſes, in deſtilled water of a burgundy wine color, is ſoon changed in the thermal water to a goſling green firſt, and then highthens to a dark amber color. Whileſt both the dry flowers and this infuſion, with the thermal water evaporated, inſtantly ſtrike a dark graſs green, and highthen in twelve hours, as before.

§ 64. Theſe two laſt experiments come in aid of the preceding, and while they ſhew no tinge of the purple or black, aſſure us there is none iron in this water,

more

more than in that of Aken; give ſome indications of an alcaline and muriatic ſalt, as in that; but, more checked in it's operation by an acid; which, like that acid alſo, appears to be volatile, but more redundant.

§ 65. 14. The ſame bright blew paper uſed at Aken and the lower fountane, is, by ſtanding in this water, almoſt diſcharged of it's color; which then appears of a roſe purple, much as in that of the lower fountane. It does not ſo ſoon, nor ſo well recover ſpots made with the lighter acids in this paper. But, upon evaporation, it ſtrikes a violet purple with the paper, and readily recovers ſpots made with the acids.

§ 66. 15. With ſirup of violets, it ſeems to ſhew a purpliſh hue at mixture; ſoon after which, the color diſappears; and then, after four or five minutes, acquires an obſcure green hue. In twelve hours, it appears of a ſad yellowiſh green. The water cold produces the ſame effects; but more ſlowly and obſcurely; whileſt the evaporated water inſtantly ſtrikes a bright graſs green.

§ 67. Theſe experiments are explaned by what has been ſayed of the ſame trials of Aken water: Here, the ſame kind of acid, but in greater quantity, from the ſlowneſs of the change of color, appears. And the like alcaline principle, from the green produced, when the acid eſcaped by ſtanding, or was expelled by evaporation.

§ 68. 16. With the Campechy log-wood or it's infuſion, the ſame color, as at Aken, is more ſlowly produced.

§ 69. 17. With cochinelle, the ſame color, as at Aken, ariſes; but, much more ſlowly.

§ 70. Theſe ſtrengthen preceding obſervations; that there is none iron, but a ſubtil acid, more abundant, and an alcaline ſalt, as in Aken water.

§ 71. 18. The alcaline ley, upon the firſt drops, makes it milky and turbid; and, in ſome hours, ſhews a palpable, white, terrene precipitate adherent to the ſides and bottom of the glaſs. In this water cold, the

effect

effect was more ſlow and inſenſible. In the evaporated, no change was wrought. The reaſon for which phaenomena may be ſeen under theſe trials upon Aken water. § 246. 25. § 247. 26 § 248.

§ 72. 19. Volatile alcalies, in a liquid form, produce analogous effects, and for the like cauſes.

§ 73. 20. The fixed and volatile alcalies, in a concrete or dry form, firſt cauſe a ſenſible ebullition, ſeemingly greater than at Aken; and then, the like milkineſs and precipitation, as with the liquid, follows. For reaſons, explaned under the like experiments at Aken. § 252.

§ 74. 21. The diluted, as well as the concentrated mineral acids cauſe a ſenſible ſtrong ebullition upon dropping into this water of the natural heat, and even quite cold. But the effect ſeems to ceaſe with a ſmaller quantity of the acid in theſe, than in the Aken waters And the little minute flocculi, which appear to flote in the water, ſeem to ſubſide, upon ſtanding ſome hours after the acids are added.

§ 75. 22. The acids, added to the evaporated water, produce the like effects, as in the evaporated Aken water.

§ 76. 23. The vegetable acids, whether ſimple, fermented or deſtilled, all produce an ebullition, upon mixture with this water; but, in a degree ſeeming inferior to that at Aken. But, particularly,

§ 77. 24. With the deſtilled vinegar, a ſmart ebullition ariſes; but, no change of color. In twelve hours ſome clouds appear, ſome ſubſiding, others ſuſpended; but, all quite colorleſs, perfectly white. In the cold water, the ebullition is ſcarce perceptible; nor is there any change of color. In the evaporated water, the ebullition is quick and ſtrong, eſpecially upon agitation; but without any change of color or precipitation.

§ 78. From what has been ſayed upon the like trials at Aken, the reaſons of theſe phaenomena will appear; particularly, the not changing of color, which is evidently owing to the ſcarcity, if not abſence, of the inflammable principle, in this water; which appears

pears further by other experiments, and which ſtrongly diſtinguiſhes it from the waters of Aken, as well as from that of the lower fountane.

§ 79. 25. The neuter ſalts, compoſed with the mineral acids, cauſe no more change in this, than in Aken, water; except,

§ 80. 26. Salt ammoniac, which is decompoſed by the evaporated water, in this, as in that.

§ 81. The reaſons for which are the ſame, as for the like effects at Aken.

§ 82. 27. A ſolution of Alum cauſes no ſenſible ebullition; it becomes milky at the fourth drop and appears of a pearl colored opacity at fiveteen drops, and ſoon after coagulates. In twelve hours, this coagulation is moſtly precipitated, in light clouds, exceding white, towards the bottom. The like effects are produced in the cold water. In the evaporated, there is a ſenſible ebullition and the like precipitation; but, more ſlowly performed. The reaſons for which, as well as the difference of the waters, will appear from what has been ſayed with relation to this experiment, upon the Aken water.

§ 83. 28. The ſolutions of mercury, in the acid of nitre, produce effects ſo nearly ſimilar to thoſe at Aken and the lower fountane, that they are hardly to be diſtinguiſhed well, when made at a diſtance, the one from the other; except, in the ebullition in this being much more inconſiderable.

§ 84. 29. The effects of the ſolution of corroſive ſublimate was analogous to thoſe in Aken water; except, that the precipitation was more colorleſs or white.

§ 85. 30. The ſolution of ſilver is attended with all the phaenomena, in this, as in the Aken water; except the change of color: For, in this, the firſt coagulation is exceding white, as the precipitate at bottom is found; whileſt a lighter precipitate, which remanes longer ſuſpended in the liquor, gets and ſhews a ſlight, ſlate-colored tinge, not much more however, than

than may ſometimes appear upon precipitating ſilver with ſome ſea ſalt.

§ 86. 31. The ſolution of lead, in the like proportion uſed in Aken water, at every drop, cauſes a beautiful, bright, white cloud, and upon increaſing to fiveteen drops, renders the whole opac, of a ſnowy white; which, in ſome hours, gives a fair precipitate of the like appearance.

§ 87. Theſe, 30. 31. Experiments, ſhew the like precipitating matter, the ſalts, but not the coloring matter, the phlogiſton, in this, as in the Aken, water.

§ 88. 32. It decompoſes the ſolutions of the green and blew vitriols, as Aken water does, rather more ſlowly.

§ 89. 33. Committed to evaporation in the ſame apparatus, it exhibits the ſame appearances and effects, as the Aken water; all to the ſmell, which could never diſtinguiſh from that of common water. Thirty five ounces afford of ſolid contents, ſeeming whiter, than thoſe of Aken waters, one drachm and ten granes.

§ 90. 34. This waſhed well with hot deſtilled water, and filtrated, the inſoluble or terrene are ſeparated from the ſoluble or ſaline parts. The remaning matter in the filtrated paper dried weighes five granes and an half. The waſhings, evaporated to dryneſs, yield of a pure white ſalt, one drachm, four granes and an half. Hence, every pint, meaſure of ſeventeen ounces and an half, contains thirty five granes of fixed ſolid contents; of which two granes and three quarters is an earthy matter and thirty two granes and a quarter a ſaline ſubſtance.

§ 91. 35. The earthy matter cauſes an ebullition with acids and partly diſſolves in them calcined in a ſtrong fire; it is partly converted to time.

§ 92. 36. The ſalt anſwers to all the trials made upon that of Aken water.

§ 93. From theſe experiments and obſervations, it may be ſafely concluded, that theſe waters conſiſt

of

of ſimple water heated in the ſame manner of Aken waters, but in an higher degree; and, like them, impregnated with a volatile acid, but little or no phlogiſton; with an earth, partly abſorbent and calcarious, partly ſelenite, in a nearly like quantity, with a greater proportion of the acid and with a lixivial or alcaline and a muriatic ſalt combined; the productions or combinations of which may be accounted for upon the ſame principles with thoſe of Aken.

§ 94. From what has been ſayed, it is eaſy to judge of the qualities of theſe waters and to what medicinal uſes they may be properly applied. From an unaccountable idle notion of their being impregnated with alum, they are never preſcribed internally, and therefore, are hardly ever drank. But, this is abſurd and ridiculous: They may be as ſafely and to as good purpoſe drank, as the waters of Aken, or the Caroline baths; where neither the inflammable principle of the one, nor the martial earth of the other is ſought. I have drank ſeveral glaſſes of them, for many days ſucceſſively; and if I might judge by one example, found them more tending to purge, than thoſe of Aken.

§ 95. Externally applied, they anſwer much the ſame purpoſes, as the Aken baths, long drawn, when they are found to loſe their volatile parts.

§ 96. Their vapor containing more of an acid, is found to be more tonic, to brace up the ſolids more, than than that of Aken waters. Therefore, it anſwers better in anaſarcas, oedemas and dropſies.

§ 97. Great ſervices are done in thoſe dropſical tumors of horſes legs, which our ferriers call greaſing; by their being bathed up to the belly in theſe waters.

§ 98. And to ſhew how innoffenſive they are even to the fiſh kind, there is not a better breeding or growing pond in all the country, than one fed by theſe waters alone, and into which, they run, hot as the human blood. In theſe heterogeneous, hot waters,

ters, carp and tench mutiplly excedingly, and grow to a very enormous ſize, in a ſhort time. But, the fiſh is not firm nor of an agreeable taſte. To remedy this inconvenience, they catch them, that are of a fit ſize in this hot pond, and throw them into a cold pond, at a ſmall diſtance. There, they are kept for ſix months, and then they are found equal in firmneſs and flavor to any in the country.

The End of the ESSAY upon BORSET WATERS.

OF THE

CITY

AND

THERMAL WATERS

OF

BATH.

ADDRESSED

To the RIGHT HONORABLE

The EARL of CHESTERFIELD.

OF THE

CITY

AND

THERMAL WATERS

OF

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ADDRESSED

To the RIGHT HONORABLE

The EARL of CHESTERFIELD.

TO

The RIGHT HONORABLE,

The EARL of CHESTERFIELD.

MY LORD,

THE man, who aims at the Public Good, though in the loweſt ſphere, is intituled to the attention of the Public and the countenance of every good man. And the more important the attempt he makes; the more potent the Patron he deſerves and requires.

This conſideration muſt juſtify me, to the world, in taking the liberty of thus addreſſing myſelf to Your Lordſhip, upon this occaſion.

Nor can I apprehend any other apology, to Your Lordſhip, neceſſary; ſince, I may reaſonably preſume, that he, who ſo vigorouſly, ſo eminently labored for the political health of the Commonwealth, can not be ſuppoſed to diſdain an humble attempt to miniſter to the bodily health of it's members.

Were the following tract a mere phyſical or chemical eſſay, which might ſtand or fall by it's own ſimple merit or demerit; however I may admire, however revere the name and

character of Lord CHESTERFIELD, as every one muſt, who attends You through the various ſtations, You have filled, as well abroad as at home, to the honor and happineſs of the King and Subjects of theſe Realms, particularly in poor Ireland, where Your image ſtill makes a part of the houſe-hold Gods of every grateful family, and where it may in truth be ſayed, Semper Honos, Nomenque tuum, Laudeſque manebunt; however ſenſibly I may be affected with Your particular Humanity to me, in private life; however thankful I may be to Your unwearied endeavours for the diſtinguiſhing Freedom and peculiar Happineſs, the Sons of Britain now enjoy; whoſe laws, while they protect her Free-born offspring, afford an Aſylum to the oppreſſed of other nations, as well as to me; however, MY LORD, I may think myſelf, with the multitude, indebted to Your Lordſhip, for theſe, among other bleſſings; I might probably, upon this occaſion, have ſpared You ſome part of the trouble, to which Your conſpicuous rank and fame expoſes You, and expreſs my particular admiration, in ſilence, or at leſt in private.

But, MY LORD, I am imbarqued in an undertaking, of too great moment, for any private, ſingle man to hope to ſuccede in fully, without the countenance, without the active aid of a perſon of dignity and influence ſuitable to the importance of the deſign.

Had I mere phyſical errors alone to encounter; ſuch is the judgement and candor of the age, that I need but expoſe them to the judicious and unprejudiced, to have them deſervedly exploded, by the ſimple force of common reaſon. But, My Lord, I have the inflexible, hoary tyrant, Cuſtom, to overthrow; many deep-rooted, perverſe prejudices to eradicate, before the public may expect to reap the full benefits of my ſcheme, be it ever ſo well founded.

The Augean ſtable had never been cleanſed, nor the Hydra ſlayen, without an Hercules; though all the parties concerned had been ever ſo ſenſible of the neceſſity of both the one and the other. This need no ſtrict application. It is enough to ſay, that without a Chesterfield, my beſt endeavors, in this inſtance, may be fruſtrated, in a great meaſure

Among the many perſons of the firſt rank, for judgement and quality, that honored me with their attention in experimentally explaning the nature and properties of our thermal waters at Bath, and expoſing the long-prevaling errors and abuſes, with reſpect to their virtues and uſes; none gave me ſo much ſatisfaction, none could have raiſed my pride ſo high, as Your Lordſhip; when I found You condeſcend to bend Your mind to that long neglected, though invaluable, branch of experimental philoſophy, Chemiſtry; which, of all

others, You muſt be preſumed to have cultivated the leſt, from want both of leiſure and opportunity; when conſiſtent with the dignity of a truly noble mind, thirſting after truth, You layed early-imbibed prejudices aſide; patiently attended to a long ſeries of experiments, introductory to a juſt knowledge of the ſubject; and received and retained the demonſtrated general rules, and that at the firſt time of their being layed down to You, ſo effectually, as to have been able to anticipate me in applying theſe afterwards to the explaning the experiments in the immediate examen of the Bath waters.

You, then, My Lord, were perfectly ſenſible of the groſs miſtakes in the received notions of the nature and qualities of theſe waters. You ſaw them in a light, different from any, in which they had hitherto been repreſented. You were, by the teſtimony of your own ſenſe and judgement, convinced, that the exquiſite compoſition of theſe waters had not before been fairly explored; that they were neither Saponaceous nor Sulphureous, Nitrous nor Alcaline; but were impregnated with the ingredients, and upon the principles, here layed down. And You did not diſdain to honor me with acknowledging the reality, more than the origine, of your generous conviction.

After this, there could be no difficulty in convincing Your Lordſhip of the extreme irregularity,

gularity, of the groſs irrationality in the general adminiſtration of theſe waters. You gave the beſt example in the oeconomy of drinking them; whileſt You well ſaw the ſhameful defect of the chief requiſites for the drinkers. Nor were You leſs ſenſible of the horrid irregularities, inelegancies, indecencies, or of the extreme riſque run, in the ill-choſen ſeaſons and ordinary manner of bathing.

It has been my froward fate to have too much of a kind of political knight-errandry interwoven with my frame. Yet, I flatter my ſelf, that none of my attempts for reformation, at leſt, none of mine intentions for the common good, can appear culpable in Your judicious eyes. You know my ſufferings: I felt them like a man. I hope, I bore them becoming a man. In the later, Your Lordſhip aſſiſted me: For, You aſſuaged the rigor of my pains, by the precious balm of generous pity.

Theſe conſidered, Your Lordſhip can not wonder at my calling for aid, for protection upon this occaſion; as You ſee, I as yet ſtand ſingle, and have multitudes to oppoſe: The taſk, I have cut out for myſelf, is nothing leſs, than the reſcuing the curious waters of Bath from ſtiff-necked, deſtructive empyriciſm; aboliſhing vane, though fondly confirmed, notions, and groundleſs, though long-eſtabliſhed, prejudices; inſtituting a rational, inſtead of a

moſt irrational practice; exploding the long-received, gothic barbariſm, with a view to revive and reeſtabliſh Roman or Attic, let me ſay, Britiſh, elegance, convenience and utility, in the Baths in general.

I may, and flatter myſelf, I ſhall be able to make the truth of my doctrine and the neceſſity of inculcating and obſerving it, as planely appear to every ſenſible, unprejudiced perſon, as I have had the honor and ſatisfaction already to have made them evident to Your Lordſhip and many other perſons of quality and taſte, at Bath.

But, as the moſt griping Miſer more freely parts with his heart-dear treaſure, than the generality of men give up long eſtabliſhed prejudices, than authors eſpecially recede from favorite poſitions; it is eaſy to judge what I have to apprehend from factions of the Doctors San Grados of the age; but eſpecially from the non-reformed phyſicians at Bath; who can not now moderate the overflowings of their invenomed choler, not even with their ſovereign Bath water; but rather encreaſe it's acrimony, as it were, with thoſe very alcalies, with which they have ſometimes fruſtrated the intention of theſe excellent waters; ſo far, as by ſpeeches, as foul and virulent as falſe, to incenſe and inflame a turbulent, mercenary Mob, and even the Mob-led corporation againſt me. And all this, while I offered to communicate all mine experiments

to

to them, without having ever arrogated to myſelf any ſuperiority to any of them; except laboring, perhaps, ſomewhat more abundantly, than moſt of them.

Yet notwithſtanding, My Lord, I mean not to make ripriſals upon theſe unkind, miſtaken, gentlemen. Nor do I preſume to look for any favor for myſelf. If I be found in error, as I muſt be liable to many, as a man; I expect, I hope, to be corrected. And be the manner of that correction, what it may; I ſhall think it my duty candidly to receive and ingenuouſly, if not gratefully, to acknowledge my conviction. If I have the good fortune to be in the right; Juſtice will, in due time take place. My particular fate is but a private concern; to attend to which, I can never preſume to think of ſoliciting your Lordſhip to ſtoop.

But, to matters of public import, I need not importune your Lordſhip to attend. Your eaſe, Your pleaſure, Your Health, have often been ſacrificed to the cauſe. Nor has the moſt afflicting, the moſt diſpiriting, indiſpoſition been able to keep You at home, when Your country called for your aid in council.

In the preſent caſe, we have private intereſt, as well as private property, joined with popular prejudices, to oppoſe the wanted reformation at Bath. But, ſure, My Lord, all theſe are to be layed aſide, when they come in competition with the common good. Bath may be

juſtly looked upon as the great Hoſpital of our Dominions, which might be extended further, and under a juſt and regular management, might prove unſpeakably ſerviceable in recovering or preſerving the health of preſent and future generations; whileſt, under an evil or irregular adminiſtration, like powerful medicines in the hands of quacks, it can anſwer few good purpoſes; unleſs by accident.

Any private man, with truth and reaſon of his ſide, may detect errors and point out the road to reformation. But the great work, the parlement alone can complete. — To Your Lordſhip then, and to them, I beg leave to commit what I have to offer upon this occaſion. And thus diſcharge at once my duty to the Public and to You.

My motive and mine intention being thus layed open to Your Lordſhip; I need not ſue for pardon for thus accoſting an heart, that ever labors with his country's cauſe. I take the liberty to addreſs You in a mode, as well as with views, ſo foregne to thoſe of ordinary addreſſes of this kind, that I muſt think it unneceſſary, if not impertinent, to apologiſe further.

Yet, My Lord, while I induſtriouſly avoid an imputation, which mine enemies can hardly lay, that of ſpeaking a language foregne to mine heart, I muſt not run towards the contrary extreme. Therefore, I muſt beg Your Lordſhip

ſhip will indulge my pride in declaring, that no man can eſteem, admire or revere Your name and character more than I do. Let me further add, that Your ſingle approbation ſhall always be eſtimated more than a recompence for any labors I can take, and that my conduct's bearing the teſt of Your exquiſite judgment muſt completely gratify the utmoſt ambition of,

My Lord,

Your Lordship's

Moſt faithful,

and

Moſt obedient,

Humble ſervant,

C. LUCAS.

Of NATURAL BATHS.

SECTION VI.

Of the CITY and WATERS of BATH.

§ 1. THE waters here ſeem to have given riſe, as well as the name to this city, as others have taken their riſe and appellation from their waters; ſuch as, Aquae, Aquis, or, by corruption, Aix. But, Bath was not the firſt name, by which this town was known. The antient Britons muſt certainly have been well acquainted with theſe waters; and though ſuch accounts of them, as may now be collected from theſe early times, are ſo interſperſed with, or wrapped up in, obſcurity and fable, that they are hardly worth relating; there is nothing more certain, than that the waters then exiſted, and were in uſe and reputation. In thoſe days, the place was called, according to one of our moſt antient hiſtorians[a], Yr ennaint Twymin, or Caer Badon; the town in the hot vale, or the fort or city of Badon; as Briſtol was then called, Caer Oder nant Badon; the city Oder in the hot valley, or Badon-vale. Bath was likewiſe called by the Britons, Caer Palladur, that is to ſay, the City of Pallas's baths or waters; from theſe hot ſprings being conſecrated to that heathen Goddeſs, for whoſe worſhip, a temple is ſayed to have been erected in earlieſt ages in this city: But this, to me, who do not underſtand the Britiſh language, ſeems doubtful; as I ſuſpect the antient heathen my-

[a] CAMDEN Britan. Bp. GIBSON's Edit. p. 87.

thology

thology was not known in Britain, before the conquering Romans introduced it. But, I leave this to be diſcuſſed by ſuch antiquaries, as may think it, what I do not, worth the while.

§ 2. Britiſh Traddition aſcribes the diſcovery of theſe waters to BLEYDEN, ſurnamed DOYTH, the magician, or ſooth-ſayer; probably the Bladdule, of more modern hyſtorians. The Britons were famed magicians in the days of yore. PLYNY looked upon this people, as ſuch adepts in this art, that he preſumes, the Perſians had learned it from the Britons. It was not however then held in the ſame contempt, to which it has ſince been brought, by juglers and other impoſters. Magic was the wiſdom of the Egyptians, the principal accompliſhment of the antient philoſophers, and a requiſite qualification for the antient kings of Perſia. It then onely meaned, a knowledge of the laws of nature and the powers of human arts. And he, that was expert in theſe, acquired the name of a magician, as that appellation has, in ſucceding times, been aſſumed and abuſed by maſters of leger de main, and ſuch like deſpicable tricks, calculated to ſurpriſe and cheat an ignorant populace. It is moſt likely, this water, if not found by chance, might have been firſt diſcovered and uſed by ſuch a philoſopher, without imputing to him any of the modern artifices of pretended magic or conjuration.

§ 3. From theſe conſiderations we may reaſonably preſume, that the Romans were not the firſt diſcoverers of theſe baths; though ſome are idly fond of giving the firſt diſcovery to the firſt conquering invader of our iſle, JULIUS CAESAR. But, beſides the doubt of CAESAR's having penetrated ſo far into Britain, it is to be preſumed, the conquerors did not hear of them long after; ſince SOLINUS, a Roman hiſtorian, who floriſhed, as is thought, about the regne of VESPASIAN, is the firſt of that nation, that mentions them. The place was then famed for Fontes calicli; it's hot ſprings or baths: For, this author,

ſpeaking

ſpeaking of Britain [a], celebrates it for many great rivers, and for hot ſprings conſecrated to Pallas, on whoſe altars perpetual lamps blazed, &c. A Roman, well accuſtomed to the hot baths of his own country, could have meaned none other bath in Britain, had any other been then known, but this; as this onely comes near deſerving the epithet, Calid.

§ 4. After this, PTOLOMY mentions this place, under the expreſſion, Ὕδατα Θερμα, Hydata Therma, Hot waters; and by determining it's latitude 53 degrees and 40 minutes, and it's proximity to Iſcalis, now Ilcheſter, ſhews, he could mean none other, than Bath. The ſame place muſt alſo have been underſtood by ANTONINUS [b], under the appellation of Aquae ſolis, the waters of Appollo or the ſun, which is evident from his placing them between Warminſter and Briſtol.

§ 5. STEPHANUS, or STEPHENS, an author mentioned by CAMBDEN, calls it Badiza, probably from the Britiſh, Badon. The Saxons alſo gave it ſeveral names, taken from it's ſalutary ſprings, ſuitable to the idiom of their language; thus, we find, it was called Ackmanceſter, from Ackman, a ſick man, and Ceſter, probably from Caſtrum, the ſame with Caer or Cahir in the Britiſh and Iriſh languages, a caſtle, fortreſs or citadel, or with us, a Roman camp; as if we ſhould ſay, the city of Valetudinarians; alſo, Bathenceſter, the City of Baths, and Hat Bathan, the Hot Baths. Hence, our appellation of Bath, and in vulgariſed Latin, Bathonia.

§ 6. It is not now poſſible, with any degree of certainty, to determine, where, or by whom, theſe waters were firſt diſcovered: Theſe hints can onely ſerve to give an idea of their antiquity. It is not improbable, they may be coeval with the formatiou of our iſle; though there would be nothing ſurpriſing in their having taken riſe much later; ſince, the ſpringing of any waters hot from the earth; their continuation and

[a] Polyhiſt. c. 22. [b] Itinerar.

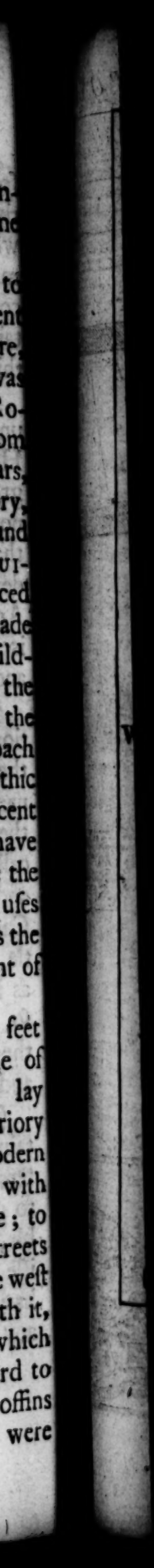
their

and their declenſion muſt depend upon ſuch circumſtances, in the bowels of the earth, as can lay no clame to perpetuity.

§ 7. The city, according to our annals appears to be of great antiquity. It is probable, the antient Britons built a city for their accommodation there, in their rude manner. This, in all likelihood, was improved, if not built to their own taſte, by the Romans; for that they long inhabited it, is evident from an infinite number of antient Coins, Statues, Altars, Inſcriptions and other monuments of Roman hiſtory, that have been, and are ſtill daily, diſcovered in and about that city; as may be ſeen in CAMDEN, GUIDOT, WOOD, and others. But, this can be evinced by nothing more planely, than by the diſcovery made this year in ſinking for a foundation for new buildings after taking down the old building, called the Abbey-houſe, adjoining the great church, called the Abbey-church. There can hardly be a greater reproach to our nation, than to find a rude, irregular gothic building founded upon the ruins of very magnificent elegant Roman baths and ſudatories; which have been celebrated by the Roman hiſtorians, while the noble ſtructures were not onely effaced, but their uſes became utterly unknown among us. Antique as the curious may expect it, I ſhall give ſome account of theſe ruins.

§ 8. They were diſcovered ſome ten or twelve feet below the ſurface of the ſoil, on the ſouth ſide of the great church; from the wall of which, they lay but a few feet diſtant. Over theſe ſtood the Priory or Abbey-houſe, as it was called; a good modern gothic building, of two ſtories high, adorned with great projecting windows, now revived into mode; to the reproach of our taſte, and annoyance of the ſtreets of our cities. When this edifice, which adjoined the weſt end of the church and made near a right angle with it, was removed, below it's rude-layed foundation, which run along the antique baths, without any regard to their foundation, ſeveral rough hewn ſtone coffins

were



A PLAN of the ROMAN BATHS and STOVES discovered under the Abby House at BATH. 1755.

Pl. II. *Part III. p. 222.*

Fig. I.

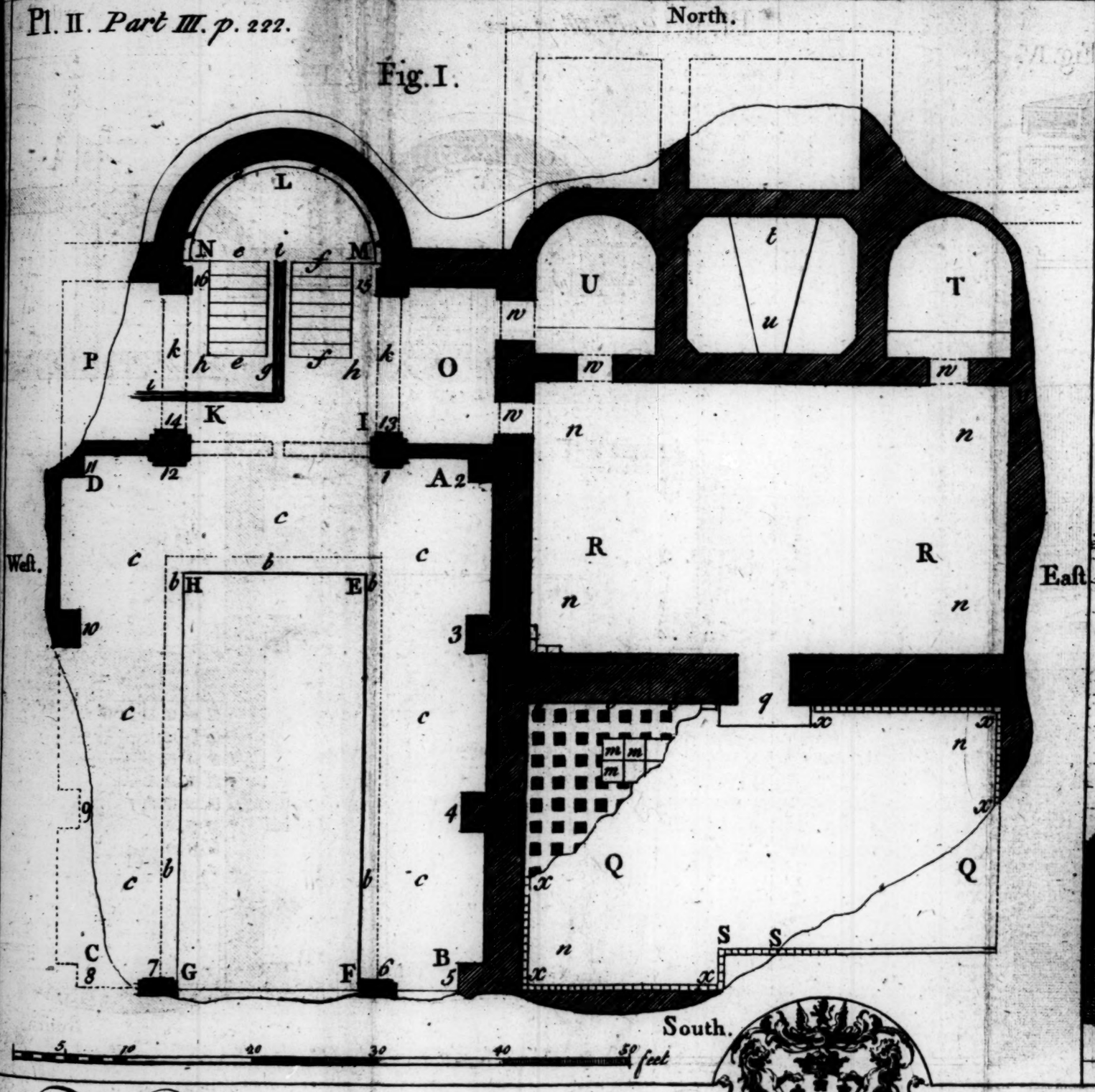


Fig. III.

Fig. IV.

Fig. II.

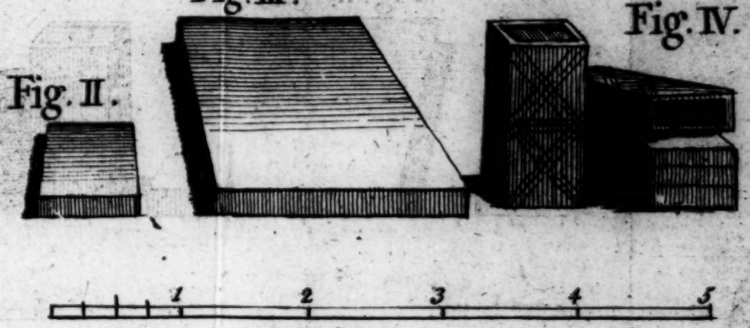
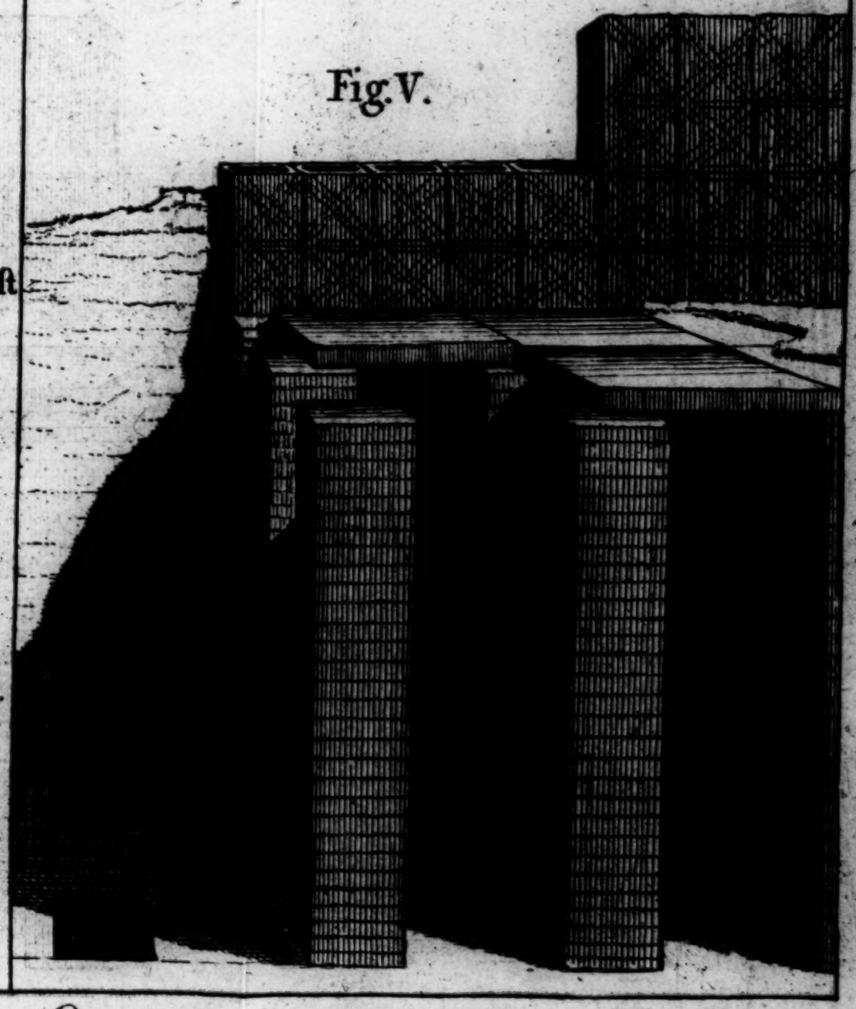


Fig. V.



With all Respect and Humility Inscribed To His Grace The DUKE of KINGSTON,
on whose Estate they are found.

were found, with the ſeeming entire, but mouldering, remanes of human bodies of different ages and ſizes; with ſome of which, ſeveral pieces of coin, as I am informed, of the ſucceſſive Saxon kings, were found buried; the number of pieces and different regnes poſſibly denoting the age of the interred. One of theſe coffins, I obſerved lying nearly level with the floors of the ſudatories; and another, which I alſo ſaw in it's place, had been layed upon the ſhaft or part of the upright of one of the pilaſters of the great bath. So that it is to be preſumed, the ruins of theſe baths were ſo far from being known, when the foundation of this laſt edifice was layed, whoſe date I can not yet trace out, that, they then hardly knew of the ground's having been before conſecrated to a chriſtian burial place.

§ 9. What now remanes of theſe baths is ſufficient to ſhew their magnificence and elegance, as well as their great convenience and utility. I ſhall begin with the great bath, to which I conſider all the reſt as appendages. This conſiſted of a room, in II plates, repreſented by the letters, A, B, C and D; whoſe dimenſions were forty three, by thirty four, feet. The roof of this was ſuſtained by twelve pilaſters, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; each of which is three feet ſix inches upon the front of the plinth, by a projection, of two feet three inches. The ſhaft of each pilaſter is of two feet eleven inches breadth, in the front, by a projection of two feet. Theſe, with the adjoining walls, *a*, *a*, *a*, *a*, which are about two feet three inches thick, probably ſuſtained an entablature, with a vaulted roof, of about thirty five feet in heighth. The pilaſters were not all exactly of the ſame dimenſions, nor ſtrictly equidiſtant.

§ 10. This room ſtood north, A, D, and ſouth, B, C. In each angle, there ſtood a pilaſter, 2, 5, 8, 11. And between each angle two, as at 3, 4, 9, 10. The ſpace betwixt the north eaſt angle, A 2, and the next pilaſter, to the weſtward, 1 A, is ſix feet; while that

that betwixt the northweſt corner pilaſter, D 11, and the next, to the eaſtward, D 12, is five feet ten inches onely. The ſpace betwixt this intermediate pair of pilaſters, 1, 12, meaſures fourteen feet ſix inches. From the north eaſt corner pilaſter, 2, to the next to the ſouthward, 3, is a ſpace of ten feet three inches; and from the ſouth eaſt corner pilaſter, 5, to the next to the northward, 4, the ſame; but, the ſpace betwixt the two intermediate pilaſters, 3, 4, on this ſide, is ten feet nine inches; to which it is to be preſumed, the ſpace on the oppoſite ſide, 9, 10, muſt have correſponded. Between the two pilaſters of the ſouth eaſt and ſouth weſt angles of this room, 5 and 8, two other pilaſters were placed, 6 and 7, each at four feet ten inches diſtant from that in the next angle to it.

§ 11. Theſe intermediate pilaſters, 6, 7, deſcribed the breadth of the bath in this room, E, F, G, H; which was eighteen feet in the clear, incloſed by a firm wall of about two feet thick, expoſed by the pricked lines at *b*, *b*, *b*, *b*, *b*. The length of this bath was twenty ſeven feet, and it's depth five. This and all the other walls were plaſtered, within and without, with very firm cement plaſter, compoſed of pounded brick, gravel and lime. This bath was paved with pennant flag[a], as the area, *c*, *c*, *c*, *c*, *c*, *c*, *c*, round it was, which meaſures eight feet in breadth. This bath I found full chiefly of broken brick and mortar; which probably once compoſed it's vaulted roof.

§ 12. The entrance into this bath and area were from the ſouth, by three different ranges or flights of ſteps of pennant flag and plaſter of eight inches riſe and nine inches tread, between 5 and 6, F and G, 7 and 8. This, in all likelihood, had it's portico and veſtibules; but, of theſe, no traces have as yet been diſcovered. This probably was the plebeans, or ſoldier's bath.

§ 13. To the northward, adjoining this room, but

[a] A ſtone that divides into ſlates of about two inches thick, is thus called at Bath.

parted now from it by a ſlender wall, with an opening of about ten inches in the middle, ſtood a room, of which one end was ſquare, as at I, K, the other, ſemicircular, as at L. From eaſt to weſt, this meaſured fourteen feet four inches; and from the crown of the ſemicircle on the north, L, to the ſouthſide, adjoining the great bath, I, K, eighteen feet, ten inches. This was ſuſtained by four pilaſters, one in each angle 13, 14, and two at the ſpringing of the circle, 15, 16.

§ 14. But this part of the bath has ſuffered ſome alteration ſince it's building; for, the ſquare part between the pilaſters was filled up to about the height of five feet, upon this two ſmaller pilaſters were ſet; on either ſide from the area betwixt theſe two ſeparate flights of ſteps were made into the ſemicircular part, L, M, N, which was all, that was now kept for a bath. In this a ſtone ſeat, *d*, *d*, *d*, *d*, eighteen inches high and ſixteen broad, was made. The two flights of ſteps, *e*, *e*, *f*, *f*, were of different dimenſions: Thoſe of the weſtern ſide, *e*, *e*, were three feet nine inches broad; thoſe on the eaſtern, *f*, *f*, four feet two inches. Each flight conſiſted of ſteps, of ſix inches in the riſe, and had been ſo uſed, as to have been worn, three inches and an half out of the ſquare, where they might have borne the impreſſion of feet.

§ 15. Thoſe flights of ſtairs were parted from each other by a little ſtone partition, *g*, *g*, upon a level with the floor, *h*, *h*, of this area; which appeared to me evidently adventitious, by no means of a piece with the original building. Along this diviſion, and along the weſt ſide of the area, a rude channel, of about three inches depth, was cut in the ſtone, as at *g*, *i*, *i*; probably, for the admiſſion of cold water, occaſionally. The floor of this bath ſeems to be upon a level with that of the great bath. This might originally have been deſigned for the patricians or nobles; but, ſeems to have ſince undergone ſome alterations, not now eaſily explaned,

§ 16. To the eaſt of the area and ſtairs of this ſemicircular bath, ſtood an elegant little room, of about five feet ſquare, as at O; adorned and ſuſtained with four pilaſters; and by broken projections of walls to the oppoſite ſide, P, there is reaſon to apprehend, that ſuch another room, by way of veſtibule, for uniformity, as well as convenience, ſtood there. Theſe were parted by walls of a different age, and workmanſhip, deſigned by the pricked lines, *k*, *k*; enough to aſſure one, they were not parts of the original building.

§ 17. Parallel to this front of the great bath, and adjoining it, to the eaſtward, ſtood the Hypocauſta, Laconica or ſtoves, of a ſingular conſtructure. They were ſeparated onely by a wall, *a*, *a*, *a*, *a*, of two feet, two inches thick, from the great bath. Theſe conſiſted of two large rooms, Q, Q, and R, R, each of the dimenſions of thirty nine, by twenty two feet. Each had a double floor; the one lay about one foot and nine inches lower than the area round the great bath, *c*, *c*, *c*, *c*. Upon this, ſtood a number of pillars, compoſed of bricks, as oppoſite to *l*, *l*, *l*, *l*, of about an inch and three quarters thick, and nine inches ſquare, one of which is repreſented Fig. II. conſolidated with ſtrong mortar, at about fourteen inches aſunder. Theſe ſuſtained a ſecond floor, compoſed of very ſtrong, hard tiles, one of which is repreſented Fig. III. of two feet ſquare, and two inches thick, as ſhewn in the floor, Q, Q, at *m*, *m*, *m*; over which were placed two layers of very firm cement mortar, each above two inches thick, which compoſed the floor, at *n*, *n*, *n*, *n*.

§ 18. In the firſt or ſouthward ſtove, Q, Q, ſixteen feet, three inches diſtant from the weſtern wall, *a*, *a*, *a*, *a*, there is a projection or break in the ſouth wall, expreſſed in the plate, at S, S, of one foot, ten inches; for a purpoſe to me inconceivable.

§ 19. To the northward of this, and adjoining it, ſtands the other ſtove, R, R, anſwering in dimenſi-

ons,

ons, all to the above break, and agreeing in the conſtructure of the floors; except, that this is about eighteen inches higher than that. Theſe are parted by a wall, *o*, *o*, *o*, *o*, three feet eleven inches thick, with the appearance of a door-way and ſill, of four feet wide, in the middle, at *q*.

§ 20. Theſe rooms were ſet round, as at *x*, *x*, *x*, *x*, with ſtrong ſquare brick tubes, one of which is repreſented, Fig. IV. Theſe were of different lengths, from ſixteen to twenty inches; the bore, ſix by three inches and an half; with two lateral openings, of about two inches ſquare and five inches aſunder in each. They communicated with the hollow between the double floors, and roſe, in ſome places, as high as the ruins of the wall; which leaves no room to doubt, that the inſide of each ſtove was furniſhed with them from bottom to top. Moreover, the north wall, *r*, *r*, of the ſecond or north ſtove, R, R, was ſet with tubes of a leſſer ſize, in an horizontal and perpendicular order. And, whileſt the ſtones and bricks, betwixt the double floors, bore moſt evident marks of fire; theſe tubes were ſtrongly charged with ſoot; which planely points out their uſes. Fig. V. gives a perſpective view of part of the pillars and tiles, that compoſed the floor, with ſome of the tubes, that ſerved for funnels, as they ſtood.

§ 21. By conſidering the nature of this ſtructure, the means, by which theſe ſtoves were heated, evidently appears; though the ſeveral furnaces, by which fire was adminiſtered, are not at preſent apparent. But, there ſtill remanes ſtrong evidence to the point, and more will probably ſtill appear, if theſe venerable ruins be as ſtrictly examined, as they deſerve: For,

§ 22. About the middle of the northern wall of the ſecond ſtove, and adjoining to it, there appear to me the ruins of one of theſe furnaces: Theſe conſiſt of ſtrong walls, of about ſixteen feet ſquare, *r*, *r*, *ſ*, *ſ*, *ſ*; with a diviſion in the center, of about three feet wide, at the farther end, *t*, and about two feet, at the near-

er end to the ſtove, *u*, where part of a broken arch ſtill remanes. All this conical paſſage and ruined arch bear ſtrong marks of having long endured the force of fire. And all about it, I found many entire pieces of burned wood, charcoal, as perfect as poſſible; which to me ſeems to put the matter out of all doubt.

§ 23. Immediately adjoining the north wall of this ſtove and the ſides of this furnace, ſo as to ſtand ſquare with the eaſt and weſt walls of the two ſtoves, *v*, *v*, *v*, and *a*, *a*, *a*, *a*; ſtand two ſemicircular chambers, T and U, whoſe dimenſions are equal, about ten feet, four inches by nine feet, ſix inches. The floors are nearly two feet, ſix inches lower, than that of the next ſtove; each teſſellated; the weſtern, U, coarſely with ſmall ſquare pebbles, all of one pale brown color; broken in ſome parts, and mended onely with plaſter. The other, to wit, that to the eaſtward, T, is more operoſe; variegated with ten rounds of different colored pebbles and red brick, and one, which is the fiveth, is checquered brown and black, in half lozenges, but not ſtrictly exact.

§ 24. Theſe, placed adjoining to the ſtove and furnace, and in an angle betwixt them, muſt neceſſarily have been kept warm. Whether they ſerved for friction rooms, for embrocation or bathing, may not now be eaſily determined with deſirable certainty. They are each lined with ſix or ſeven different coats of reddiſh cement plaſter. And the eaſtward one ſeems to have an opening, or tube, to the northward, in the crown of the ſemicircle; by which, water might be diſcharged. Theſe rendered them fit either for baths or embrocations.

§ 25. To the northward ſtill of theſe, appear the ruins of two ſquare chambers of more ordinary work, without any thing remarkable. Theſe probably might have made part of the habitations or lodges of the keepers or attendants of the baths. Much more may yet be diſcovered, if duly ſought. Theſe are enough

for

for my purpoſe. To inveſtigate them, I made a ſecond viſit to Bath. They ſerve to prove, what I aſſerted upon the authority of SOLINUS, long before I knew of them; that we once had regular, rational and elegant baths in Britain, upon the Roman plan, which we rejected and changed for the preſent rude barbarous, Gothic baths, that reproach us with want of ſenſe and elegance, in theſe matters.

§ 26. When, theſe venerable ſtructures might have been raiſed, is an enquiry, that may exerciſe the genius of our antiquarians. I think them Roman; becauſe the Britons did not, that we can find, know the method of building with ſtone or brick and mortar; and becauſe the laſt cited hiſtorian mentions baths in Britain ſumptuouſly and elegantly adorned and accommodated to our purpoſes. Wherefore, I take theſe to have been the identical baths, he meaned. Their Antiquity may be conceived from this, that the Roman Invaders were forced to quit our Iſle, about the year 420.

§ 27 It is obſervable, that theſe baths were built long before the ſite of the city was raiſed to what it now appears; for, they are now too low to have their waters drained off by any of the ſewers, that ſerve the other baths or the ſtreets and houſes of the town.

§ 28. The raiſing the ſoil, which is common to all cities as well as to this, is the cauſe, why the water riſes higher in theſe antique baths, than could have been at firſt intended. It riſes three feet, two inches above the area of the great bath; that is, eight feet two inches above the bottom of the bath; becauſe it's proper ſewers are ſtopped or deſtroyed; and thoſe, made later, are too high to receive the water of this more antient bath The bottom of the King's bath is about nine feet higher than that of this Roman bath.

§ 29. When I firſt viſited theſe venerable ruins of Roman antiquity, I found them full of water. I had them drained out by pumping, and then took the dimenſions, by the help of Mr. WOOD, the architect, and his aſſiſtant, Mr. HOLLAND; and made mine obſervations. To the former, I am indebted for the plan

hereunto annexed. Which, I have taken the liberty of altering, agreeable to the dimenſions, that appeared to me. Mr. WOOD ſhewed his genius, in correctneſs and taſte, which did not appear in the work. He has alſo pointed out doors or opens, where probably they ſhould have been, but actually were not to be ſeen, as at *k*, *k*, *w*, *w*, *w*, *w*; which I therefore marked with pricked lines.

§ 30. From almoſt every part of the great and the ſemicircular bath, that ranges with it, conſiderable quantities of water ſprung in, which was hot enough to raiſe the thermometer from 70 to 104. This water upon ſtrict analyſis, appeared the ſame, in all other reſpects, with that of the King's bath. But, whether or no that was derived from the ſame ſource with this, I was not permitted to determine, by opening the ground further, as I propoſed, about the former bath. It is not to be doubted, that the ingenious builders of theſe ſuperb baths ſecured a fit ſupply of water both hot and cold. Though, whence it was drawn, has not yet been diſcovered. They might more judiciouſly and properly have conveyed the waters of the great ſource thither, which is about an hundred and thirty two feet from it, and which is ſufficient to furniſh many ſuch baths; than incloſe the entire ſpring to make one rude open ciſtern for bathing, which was done after the Roman baths were demoliſhed and buried in Gothic barbariſm. But, that theſe are not the baths, obſerved by LELAND [a] in the Priory-houſe, as ſome have idly imagined, is evident from theſe lying low beneath the foundation of that building, with many Saxon coffins betwixt them. Beſides, the front wall of the Abbey or Prior's houſe, ſtood nearly at G, H, K, N; the rear wall, over the ſtoves, &c. Q, R, U; which leaves no room for even a doubt of theſe baths having been known to the builders of this Gothic edifice.

§ 31. How theſe magnificent baths became neglected, ruined and loſſed, can onely be conjectured.

[a] Itiner.

Poſſi-

Poſſibly, the yet uncivilíſed Britons took the firſt opportunity of effacing all monuments of their conquerors. Perhaps, they were deſtroyed in the Saxon wars and ſieges of this city. That they lay long neglected, as a waſte place, deemed fit to receive carion, ordure and rubbiſh of every kind, appears from various ſculs and bones of different animals, aquatic and terreſtrial, which lay perfect and entire in the baths; particularly one entire and ſeveral broken human ſculs, and other bones. And, at a certain level all round, the walls of the baths were thick ſet with a great variety of great and ſmall ſhells of water ſnails. Theſe lye upon the walls, at about three feet three inches higher, than the floor of the area. In further proofs of which notions, it is obſervable, that the water reſts at about this highth now. Another proof, that the baths lay a long time full of water, before they were quite overwhelmed, is that I found the walls of the baths, whether ſtone or mortar, fairly incruſted over with an hard, white petrification.

§ 32. From the correſpondence, which theſe baths appear to have had, with thoſe of the antient Romans, I think it is hardly to be doubted, that they were built when theſe conquering invaders were maſters of our iſle. And I think it more than probable, it is to theſe, SOLINUS alludes.

§ 33. The preſent city was probably built by the Saxons, after the Roman manner, imbeliſhing their walls, with all the ſtatues and other monuments of that people, they found in their way. But, leaving this diſquiſition to thoſe, who have more time and leiſure, I ſhall procede to what more nearly concerns mine enquiries, as a phyſician.

§ 34. Bath, like moſt antient cities, ſeems to have been founded with no regard to it's ſituation. Accident gave riſe to moſt; but, the waters certainly firſt induced men to build where this city ſtands.

§ 35. Bath has ſuffered many conflagrations and other devaſtations at different times; and ſtill roſe more

beautiful from ruins. After the Saxon demolition, in 1088, the town was again raiſed, and incloſed in an old fortification, in the Roman manner; conſiſting of an high wall, with ſtrong gates and towers, environed by a ditch. It ſtands in a narrow deep valley, upon the banks of the river Avon, cloſely ſurrounded on every ſide by lofty hills; particularly, to the north, by Landſdown, to the eaſt, by Clerkendown, and to the ſouth, by Beechencliff; ſo that there is no going into, or out of, the town, except towards Briſtol, which is to the weſtward; without paſſing a precipice. The river runs a beautiful ſerpentine courſe along this valley, and bounds the city, from the north eaſt, to the ſouth weſt. The vale is a very rich, fertile ſoil, and would every where afford a moſt beautiful proſpect to the city, were not the hills too near to moſt parts, from whence they are viſible.

§ 36. The ſtreets of the old town are exceding narrow; ſo that in ſome, no wheeled carriage can paſs, and in the chief, ſcarce can two carriages paſs each other.

§ 37. But, this vitious taſte has been corrected in all the modern buildings in the town: they are layed out in grand ſtreets and elegant ſquares, with great propriety, true taſte and magnificence. So that few cities can boaſt as good, and none better, buildings, than Bath now can. Nor have the modern builders confined themſelves within the contracted limits of the town walls: theſe are now totally diſregarded, and the beſt buildings carried beyond their narrow precincts. Of theſe, the noble pi.s of building, called the Parades, the Queen's ſquare, and the King's circus, all planned and executed by the late famous Mr. WOOD, author of the Eſſay towards a deſcription of Bath, and his ſon, are eminent proofs.

§ 38. Bath, by modern computation, ſtands in W. longitude 2 deg. 30 min. latitude 51 deg. 30 min. 90 miles, ſouth weſt, from London, 14 eaſt of Briſ-

Briſtol, 20 north eaſt of Wells, in the county of Somerſet.

§ 39. It's ſituation, in a moſt fertile country, and upon a navigable river, which flows through one of the moſt famous marts in Europe, Briſtol, provides it plentifully with all the commodities of life, that may be produced by land or by water, whether from the ſoil, from other parts of the kingdom by land carriage, or by the moſt extended commerce by water.

§ 40. Hence, this city is furniſhed with all things that can, in any ſenſe, be found neceſſary for the common conveniencies of life, from the moſt magnificent houſes and ſumptuous tables, to the moſt private lodging and boarding. And nothing would have been left wanting in that way, did the inhabitants, who let lodgings, but pay their ſervants wages, ſo that they may not depend for ſupport, and often inſolently prey, upon ſtrangers; to the indelible reproach of the town; a ſhameful vice, which I wiſh had been leſs chargeable upon our country in general, than it is found. But alas! Venality is the baneful vice of our age; and till the ſuperior claſs of men are found proof againſt the allurements of corruption, the inferior are hardly to be condemned for it.

§ 41. The moſt part of the old city, and all that ſtands low, is built in a moraſs, where it was difficult to get a foundation. About it, the ſoil in general is loamy and gravelly; in ſome places rocky and dry; but, from the highth of the hills, which are often ſeen cloud-capped, many ſprings and other ſtreams of water are produced, all which bend their courſes towards the city, which lies in the bottom of the vale. Hence, it is ſupplied with great plenty of water. With this, ſome parts of the town are furniſhed by aqueducts, from the ſprings in the neighbouring hills; others, by ſprings, pumps, or other wells in the town, of which there is great plenty.

§ 42. Some of theſe waters are pretty light and ſoft, but moſtly terrene and hard; ſome are even ſayed to

be brackiſh or ſaltiſh to the taſte. A certain flint phial, with a well adapted ſtopple, weighing two ounces four drachms and fourteen granes, which, filled with cold deſtilled water, weighed four ounces, ſix drachms and fiveteen granes, filled with the beſt pipe water, weighed four ounces, ſix drachms and above fiveteen granes and an half, and with moſt of the pump waters, above a grane, and with ſome above two granes more. The river water appears foul and muddy, of a kind of whey color, viewed as it ſtands in the river. Freed from this foulneſs, by ſubſidence, it is fit for moſt of the common uſes of life. The pipe water is not free from acidity here; for upon dropping the ley of tartar into it, it not onely grows milky, but, by an ebullition, gives evident marks of a contraſt between the alcali and an acid. In boiling, it coats the veſſel.

§ 43. To form a right judgement of the Air of Bath, it will be neceſſary to conſider it's ſituation, the ſoil in and about the city, the waters ſimple and medicated, together with it's various other products, and the fewel commonly uſed in the town.

§ 44. From it's ſituation, the air muſt be confined, conſequently charged in proportion with all the vapors and exhalations, with which it is by any means impregnated. From the quantity of water, hot, as well as cold, diſcharged from the neighbouring hills into, or ſpringing up in, the vale, in which the town ſtands, it muſt be damp. To this, the ſhade of the high hill to the ſouthward, Beechencliff, muſt greatly contribute; eſpecially in winter, and muſt, in ſome meaſure, deprive the lower part of the town of the benefits, which might otherwiſe accrue from it's lying on the north and weſt ſide of the river. This dampneſs of air muſt be increaſed and complicated by the vapors and exhalations of the baths and their minerals. This muſt neceſſarily be it's caſe in winter. In ſummer, from the confinement of the air, and the reflection of the ſun's heat from the hills, it muſt be extremely hot. The natural effects of heat, moiſture, and air in any

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degree confined or ſtagnated, muſt be very obvious to all, that conſider the uſe and neceſſity of clear, temperate, free air, to almoſt all beings, that have vegitative, as well as animal life, particularly to man.

§ 45. In order to help our conceptions in this inſtance, it is requiſite to take a more particular view of the products of the ſoil in and about the neighbourhood of the city.

§ 46. Beſides the common fertile earths of fields and gardens, which are here equal to any in the kingdom, there are found clays or loams of various kinds, fit for bricks, tiles, furnaces, and earthen ware; as well as fuller's earth and marle.

§ 47. Beſides flint, grit, and lime-ſtone of various kinds, there is a ſort of free-ſtone, of a yellowiſh color, and very conſiderable ſize, found in plenty in the hills to the ſouthward of the town. This ſtone is peculiar to this neighbourhood, and has obtained the name of Bath-ſtone. It is of a gritty ſubſtance, and of ſo ſoft a conſiſtency, that it is chipped, with kinds of axes, as wood; and may, at a ſmall expence, be wrought into any form. But, this conſiſtency mends, as the color alſo does, in the air: For, it becomes exceding hard and durable, and of a fair white color[a]. This ſtone bears great analogy to that, with which Paris is built. It is very remarkable of both, that one layer of this ſtone, of a conſiderable depth in the quarry, is made up of ſmall ſea-fiſh ſhells, which are however found more diſtinct about Paris, than I have yet been able to obſerve them about Bath. In theſe, Mr. HAVILAND has ſhewn me very fair, large oiſter ſhells. It will not then be wondered, that they alike cauſe ebullitions with, and partly diſſolve in, acids.

§ 48. But, foſſil ſhells are not confined to this deep quarry ſolely: They are found plentifully and of great

[a] Quaere, is this Cos particularis minimis glareoſis, mollis; caedua; of WALLERIUS? Cos quadrum, of CAESALPINUS?—quadratum, of ALBERTUS? Saxi alterum genus of AGRICOLA? See WALLERIUS's Mineralogie, p. 144.

variety

variety in moſt other quarries, and even upon the tops of the higheſt hills in the county. Of theſe, I have had great variety: ſuch as Oiſters of various kinds and ſizes; Nautilli of the largeſt kinds, and Cornua Ammonis, of three or four different kinds and of various ſizes, from a few inches, to upwards of two feet in diameter; all perfectly petrified; ſome into bright cryſtalliſed ſpar. My collection of theſe like productions was greatly increaſed by the ſkill and aſſiduity of the ingenious Mr. WOULFE, who brought me from the tops of the higheſt mountanes in this county, particularly about Briſtol, ſeveral of thoſe productions, long deemed vegetable, till by the labor and ingenuity of the curious Mr. ELLIS [a], they have lately been demonſtrated to be the works of animal bodies; I mean, Corals, Coralloides, Madripores, &c. of which we find great abundance all over the hilly and rocky parts of this country. Mr. HAVILAND has a very large and complete collection of wood, bones and ſhells of fiſhes, to an extreme variety, found in the quarries, ſand-pits, and loam, about Somerſetſhire; particularly, in the neighbourhood of Bath. This ſhews ſome moſt extraordinary revolutions in our earth; at leſt, that theſe parts of it lay deeply overwhelmed by the ſea; and that probably not for years, but ages.

§ 49. Here, is alſo found ſeveral kinds of marble, ſpars, and ſtalactites; of the later eſpecially about Oakey-hole, near Wells. As alſo Black ſlate, or, as ſome call it, Tegula vel Lapis Hibernicus, Iriſh ſlate, in all the coal mines, with which this part of the country, eſpecially towards Briſtol, abounds. In this ſoft, fiſſil ſtone, impreſſions of fiſhes, and ſometimes of fern and other plants, are often found. Some of theſe have an acid, and ferrugineous or vitriolic taſte; and, upon waſhing, yield a ſubacid, chalybeate water.

[a] Eſſay towards a natural hiſtory of Coralline, and other marine productions of the like kind, commonly found on the coaſts of Great Britain and Ireland.

§ 50.

§ 50. In this tract, many metallic minerals are likewise found; particularly, Calamine or Cadmy, about Mendip-hills, in great plenty. With this, lead-ore is there generally united. Hence, Zinc or Spelter may be made to great advantage. But, such has been our infatuation, that, though one of our countrymen, the ingenious Mr. CHAMPION of Briſtol, found means of preparing this uſeful metallic amongſt us, and that of materials, all the product of our own ſoil; yet the intereſt of a certain monopoliſing company, which inriches itſelf by a trade apparently deſtructive to the commonwealth, and imports much of this commodity from abroad, was preferred to the public good, and the encouragement moſt juſtly due to the valuable diſcovery of this uſeful and ornamental member of ſociety!

§ 51. There is likewiſe great plenty of Pyrites found not onely in the coal-mines, but in many of the quarries and ſand or gravel-pits all over this county, and particularly in the near neighbourhood of Bath. Such of theſe, as I have been able to collect, were purely martial, and ſo little impregnated with ſulphur, as to afford none by fuſion, and little or none by ſublimation. But, it does not hence follow, that there may not be ſome, much richer in ſulphur, conceled from ſight; it is probable, there are. The kinds, I ſaw here, were the ſame with thoſe about Aken[a], with more of the cryſtalliſed.

§ 52. The city is plentifully furniſhed with a very excellent coal; it is taken up in very large glebes, compact and ſhining. It emits no very groſs ſmoak in burning, but gives a bright, lucid flame, and white or pale aſhes. This coal is the common fewel in town and in the neighbourhood round. But, ſuch as prefer wood for their chambers, may have it.

§ 53. There is great variety of vegetables, in the county of Somerſet; but little in the neighbourhood

[a] Aken, § 73. 2. § 359, 360, and foll.

of

of Bath, from the ſameneſs or little variety of the ſoil. In the river and the ſmall marſhes adjoining, the plants common to ſuch places, all over the kingdom, are found in plenty and vigor. There are conſiderable foreſts and woods alſo in the county; but little or none near the town; except ſome few plantations. In theſe, there is nothing remarkable. The hills, which are for the moſt part fertile, produce ſuch plants in plenty and perfection, as are found in the like ſoil in other parts of the kingdom. And the gardens afford good ſupplies of the beſt eſculent vegetables, of all kinds, in their ſeaſons. Nor are medicinal plants wanting there; for, beſides what nature ſpontaneouſly yields, Mr. THOMAS HAVILAND, before mentioned, an excellent apothecary, and an accurate botaniſt, has a garden furniſhed with a curious variety of ſuch ſimples. And, while I touch upon this branch, let me take ſome curſory notice of the ſtate of phyſic in general, in this famed city. There are, as I am informed, near twenty phyſicians, who practiſe there in the ſeaſons, as they are called; above thirty apothecaries, who conſtantly live there, many of whom make fortunes, without dealing in Bath waters; and chirurgeons not a few, ſome of whom, it is ſayed, are occaſionally of any or all the other branches: Theſe may be thought comfortable conſiderations for the ſick, who need not fear the want of any other phyſical aid, in caſe the waters ſhould fail at Bath, or their ſources be exhauſted.

§ 54. Though it has at all times been the fate of Bath, as well as now, to have many of the attending phyſicians there but under-graduates in phyſic of our univerſities, ſuch as Batchelors of phyſic, a degree, which gives but the bare legal qualification to practice, or that of Maſters of arts, which alone gives no qualification; yet, have I heard, that ſuch under-graduates have thought fit to make unbecoming diſtinctions, by arrogating to themſelves a ſuperiority, to the full graduates of all other univerſities. Though not a member of any Britiſh or Iriſh univerſity, I hold myſelf bound to pay

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the utmoſt deference and reſpect to theſe moſt learned, moſt venerable ſeminaries. But, ſure no worthy member of theſe juſtly celebrated univerſities can think himſelf by any degrees authoriſed to ſpurn at others. No man can deny, that phyſic in all it's branches, is at leſt as well taught in Paris, Leyden, and Edinburgh, as in Dublin, Cambridge or Oxford.[a] And ſurely, a bare diploma, which any man may have in courſe, by his ſtanding, in any faculty, in any univerſity, cannot give ſuch a graduate any preeminence to the man, who, upon ſtanding the proper teſts, has obtained the degrees in any reputable univerſity, or even to him, who has in any other reſpect, but the diploma, qualified himſelf for the arduous taſk of phyſic. The phyſician, like the poet, is to be born ſuch; he muſt be framed by nature; he can never be made by art alone. Some teſt ſhould, indeed, be eſtabliſhed, that every pretender may not intrude into the profeſſion, and abuſe the public. That, the law has wiſely placed in the college of phyſicians. They, and none elſe, ſhould, or can have a right to examine or object, without viſible inſufficiency; in which caſe, ſuperior reaſon ſhould always determine.

§ 55. From the great number and variety of caſes, which of late years have been ſent to Bath for relief; the gentlemen, who practiſe phyſic there, have been inſenſibly induced to aſſume to themſelves a ſuperority to the learned of the ſame gown univerſally, and to look upon every caſe, brought before them, not ſo much as a patient ſent to the waters, but as an appeal from an inferior to a ſuperior tribunal. Whileſt, perhaps, the onely inſtance of the practice of the preceding phyſicians approved, is that of the appeal, or ſending the patient to the wells; which the awful, ſalutiferous ſenate of Bath, do not heſitate at pronouncing, wiſe

[a] Is it not an object worthy the attention of the legiſlature, that the endowed profeſſorſhips of ſeveral branches of phyſic, in our univerſities, are become ſine cures?

and

and juſt in general; but often, as indeed it ſometimes is, untimely; that is, too late.

§ 56. We have lived to ſee this conceit riſe to a pitch of extravagance, unbecoming a profeſſion, that can have none other foundation than ſolid reaſon and common ſenſe: for, few are capable of judging of the capacity of a phyſician; every man of ſenſe is a judge of his intellectuals. If theſe be unſound, though the vaunting academician ſhould have BOERHAAVES or PETITS, for his profeſſors or preceptors; though he ſhould have MEADS, WILMOTS, or TAYLORS for his examples in practice; and though all the univerſities on the globe combined, they can but make him a graduate, a doctor of any faculty; but, they can never make him a phyſician.

§ 57. What ſhall we then judge of ſuch men as never heared, or perhaps ſaw, a phyſic-profeſſor, in any univerſity, except at a commencement; and yet arrogate to themſelves a moſt extravagant and groundleſs ſuperiority to all men of the profeſſion elſewhere? Who nicely diſtinguiſh betwixt what they call regular and irregular phyſicians; by the former of which, they onely mean a man, who went formally through the common literary college courſe; though perhaps, without having a ſingle opportunity of learning any one branch of phyſic effectually? While they brand him with the name of irregular, who beginning with the inferior, the miniſterial branches, and making himſelf maſter of them, gradually roſe to the judicial part, the head of the profeſſion; fairly, meritoriouſly obtaining the legal qualification to practice!

§ 58. Theſe diſtinctions, however abſurd, have been found of great uſe to the craft at Bath, as well as elſewhere. But, the miniſters of health, in that city, have not ſtopped here: They have not, in their converſation, even with their patients, baulked at reflections as indecent as unjuſt, againſt a body, that ſince it's foundation has been looked upon with reſpect and vene-

veneration by all the learned ſocieties, particularly all the faculties of phyſic in Europe. It is unneceſſary to name the royal college of phyſicians here. Yet, who would believe it?— againſt the moſt illuſtrious members of this moſt learned and reſpectable ſociety, have ſome practicioners, ſome of the regulars, at Bath, made a charge of empyriciſm; as if the Londoners, beyond the known effects of bleeding and other evacuations, and of the Peruvian bark, opium, &c. could do nothing; while the Bathonians, ſtrictly rational, as well as moſt formally regular, by their perfect acquaintance with the conſtituent parts of ſimple and compound medicines, eſpecially thoſe of their univerſal agent, the Bath waters, and by their intimate knowledge in anatomy and phyſiology, being able to account for all the effects and operations of medicines, rationally, regularly; are able to extend the practice to the utmoſt limits; far beyond the ſcope of any, who do not inſpire the ſteams of Bath water.

§ 59. Is this the language of Bath phyſicians? of gentlemen? of men of ſenſe or manners? Is this the behavior of regulars? or of men regularly irregular? Is this juſt? Is it true?—As this kind of calumny requires no ſerious anſwer; I ſhall take no further notice of it here. But, ſhall point out where the charge of empyriciſm falls, when gentlemen, laying aſide their aſſerted notions of the impregnation of the Bath waters, are forced to take refuge under the wings of their late condemned empyriciſm, in appologiſing for their practice, which they now boaſt of being founded in experience. Could the higheſt or loweſt of the moſt infamous, deſtructive quacks, that thin and diſgrace our ſtate, go further?—But, enough of this.

§ 60. There are ſeveral hoſpitals at Bath, where the free uſe of the waters has, by the authority of the legiſlature, been ſecured to the poor. And Lady SCUDAMORE appointed a ſalary for a phyſician to be annually choſen by the Mayor and Aldermen, to give his advice daily, gratis, to the poor and needy. This

appears by an inſcription upon a braſs plate near the common pump, on the weſt ſide of the Queen's bath. But, I could never learn how, or by whom, that charity is adminiſtred. Poſſibly, it may be abſorbed by BILLET's hoſpital for the ſupport of a number of poor at the baths, from April to September incluſive, once the onely ſeaſon for uſing them; or by that moſt excellent charitable inſtitution, the GENERAL HOSPITAL or INFIRMARY. Here, all fit objects, of both ſexes, to about two hundred, are furniſhed with all the neceſſaries of life, with the baths and all other requiſite forms of medicine; and it is evident, that the funds, which chiefly ariſe from the ſame noble ſource, that founded, finiſhed, and has hitherto ſupported the hoſpital, voluntary, charitable contributions, are expended with due care and frugality. One great purpoſe, and probably not one of the leſt conſiderable ends of the inſtitution, I muſt, with concern, obſerve, is not attended to, as it merits. Nothing could prove more generally beneficial, than giving hiſtories of the caſes treated at Bath. As private perſons might not chooſe to have their names and caſes made public, this hoſpital furniſhes fit ſubjects and means to convey ſuch hiſtories to the public. Every patient coming from far, is to have his caſe certified, firſt by a phyſician, that he is deemed a fit ſubject for the waters, and ſecondly, by the miniſter of the pariſh, whence he comes, that he is a worthy object of the charity. Others are received by the attending phyſicians, as they appear fit, and there happen to be vacancies. Now, nothing could conduce more to the benefit and ſatisfaction of the public, than hiſtories of the bad, as well as good, ſucceſs of theſe waters, in the great variety of caſes, in which they are uſed in this hoſpital. It would be making the foundation ſerve every good purpoſe, that may be expected from it. This might be eaſily done by every phyſician's ſetting down in his hoſpital book, the caſe of the patient, and keeping a diary of the progreſs made in his cure. This may be publiſhed, when

when the patient is diſcharged, either cured, incurable, or dead. The advantages, that muſt accrue from this method, are too obvious to require any illuſtration. I am perſuaded, this muſt have been one of the ends of the inſtitution. But, I am ſorry to find, it has never, that I can learn, been fully obſerved: For, upon looking over the phyſicians' books at the hoſpital, I could find onely names and preſcriptions, without any regular ſtate of the caſe, or hiſtory of the progreſs, ſet down; except ſome few, which ſeem very ſuccinctly, accurately and learnedly layed down by that eminent practicioner, Dr. OLIVER. If more of the phyſicians were admitted to attend this hoſpital, without the mean diſtinction, which a pitiful, ſordid jealouſy alone could keep up, and the governors gave it in charge; a generous emulation might be ſtirred up; and if all the hoſpital phyſicians did not, ſome of them might, ſet down and publiſh the hiſtories of their particular patients, for the good of the hoſpital, the honor of the profeſſion, and the juſt ſatisfaction of the public in general, of the founders and ſupporters of this charity in particular. This might probably have been done, had not one particular ſet of phyſicians at Bath apprehended, that they had a right to make a monopoly of all the honors and all the emoluments of the profeſſion, which the wiſe laws of our country, as well as the ſacred inſtitutes of phyſical polity, deteſt and abhor.

§ 61. The government of Bath, and the conduct of the baths, were early veſted, and long continued, in clerical hands. William Rufus granted them to the biſhop John of Tours, in the year 1090. who raiſed it from the ruins and devaſtations, occaſioned by the Saxon wars, and reſtored the baths, with the principal buildings, in ſome meaſure: For, he did not rebuild thoſe of the Romans, the foundation and ruins of which were buried under his palace; but, he incloſed the heads of the chief ſprings, then known, with ſtrong, though rude, ciſterns; which remane,

with very little improvement, to this day. He, or his munificent ſucceſſor, Fitz Jocelin, made two baths for his priory, which were ſupplied with water from the king's bath; for ſo LELAND obſerved them, when he wrote his Itinerary [a] in 1542. After the diſſolution of monaſteries, the government of the city and baths fell into the hands of the laity, about the year 1544. About the year 1560. the ſite of the priory and the lands of Bath were veſted in Edward Colthurſt, Eſq; the corporation of Bath then became tenants of the baths, ſubject to the yearly rent of ten pounds to the crown. In the year 1590. a new charter was granted to the mayor, aldermen and citizens of Bath, by the great ELIZABETH; by which their leaſe of the waters is made perpetual, and they become public truſtees and guardians, not abſolute owners, of the baths. The town, being within the county of Somerſet, is ſubject to the ſame government with every other county in England; but, there is a particular juriſdiction veſted in the officers of the corporation, which conſiſts of a mayor, aldermen and a common council, of preſerving the peace, regulating the markets, making By-laws for better government, and determining ſmall ſuits. I need not mention what they falſely call, the freemen, or the citizens, as they are ſtiled in Queen ELIZABETH's charter; for, theſe are now left no benefit of freedom, but a barbarous excluſive right to trade in the city: For, though they be the Many, their beſt privileges, ſuch as that of electing magiſtrates, common council, and repreſentatives in parlement for the city, are abſorbed here, as, in many other corporations, by the Few.— A political, epidemic diſtemper in Britain and Ireland, beyond the reach of phyſic, though ſeconded by Bath water!

§ 62. From theſe ſhort and general ſketches, the nature of the climate, the air, ſoil, ſimple waters, and other commodities of life, at Bath, with an idea

[a] HEARNE's edit. Oxford 1744. Vol. ii. p. 38.

of the civil government there, are eaſily conceived. If we conſider the native inhabitants of Bath, we find them ſubject to no particular endemial diſorder. And they are in general, as healthy and as remarkable for longevity, as the people of moſt other parts of the kingdom. And, as to ſtrangers, they are as much at their eaſe at Bath, as they can be any where. In ſo much, that, of late, it is frequented more for pleaſure, than for health. Hence, it appears, they are liable to no diſorders here, but what they bring with them, or ſuch as, by a ſoft, indolent, inactive, luxurious life, made up of dreſſing, banquetings, aſſemblies and gaming, muſt be induced, wherever ſenſeleſs faſhion ſways as ſovereign lord.

§ 63. It muſt be confeſſed, that the ſituation and eſtabliſhed oeconomy of the place tend too much to excite this inaction and indolence: For, the paſſages into and out of the town are moſtly ſtoney, ſteep and diſagreeable, if not dangerous to carriages and horſemen. The pavements of the ſtreets are in many places, broad, flat, ſlippery ſtones. And there is not ſufficient care taken to mend and level the high ways to and from this city, and little or no regard is payed to the making convenient walks about it. Hence, when men can not have recourſe to the more manly and healthful exerciſes abroad, they are tempted to fall too much into effeminate and enervating amuſements at home.

§ 64. Now, let us take a view of the medicated ſprings or baths of this city, and by demonſtrating, upon rational principles, the nature of this curious natural compoſition, fairly explane the inducements for frequenting this city of pleaſure for health.

§ 65. If we truſt to the generality of writers on theſe waters, for proofs of their effects, we ſhall find ourſelves as much deceived, as in truſting to any of thoſe, that wrote upon the waters of the cities or other places, where they were engaged in practice: When ſuch prove competent judges, which has rarely, if ever yet, happened, unaccountable prejudices take

and ſupply the place of truth and ſound reaſoning. How few of the numberleſs authors of this claſs do we find, that attempt a rational inveſtigation of the qualities or virtues of the water, they treat?—And yet, how few of the long catalogue of diſtempers, that imbitters and ſhortens the life of man, would theſe authors have us believe out of the reach of their univerſally-extolled waters?—Hardly one!—How can the public be ſo long deceived in ſuch matters?—Nothing more eaſily done. The public, though a many-headed monſter, is as eaſily hood-winked, as if it had but one head or one eye. The multitude is as often, as ſenſibly, affected by artful falſehoods, as by plane truths, and frequently more ſo. Man is a gregarious animal. And, as in every flock of ſheep, ſo in every herd of men, there is one, who bears the bell, and, by it's tinkling ſound, leads the reſt. Forms, faſhions and flattery rule the world; and a man may as well refuſe to eat modiſh ſtinking wild fowl or veniſon at a great man's feaſt, be inſenſible of the beauty of his miſtreſs, hound or horſe, or diſreliſh any other prevaling vice or folly, as decline drinking of his favorite ſpring, or deny having received benefit from it.

§ 66. But, this is not all.—A total ignorance, of the nature of ſimple, as well as medicated, waters, almoſt univerſally prevales. Yet, waters are more preſcribed than ever! And few or none have the honeſty or candor to acknowledge their ignorance of, or unacquaintance with, any famed medicinal ſpring or bath, foregne or native! What then is the courſe of practice, in chronic caſes particularly?—When the patient grows weary of his courſe, and, perhaps, of his phyſician; or when the phyſician himſelf ſees and confeſſes a courſe of officinal medicines takes none effect; then, mineral waters or baths are ſpoke of; no matter whether firſt by the patient, or the preſcriber; they are generally approved by both, and the patient is diſpatched to drink waters, for the uſe of which,

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he rarely gets any rules, till he conſults the phyſician of the place. This gentleman muſt have more honeſty, than politeneſs, if he diſapproves the practice of his honored, though remote, brother, who ſent a ſubject to his dominions. That has hardly ever been, and probably hardly ever will be, the caſe. Waters are preſcribed; waters are and muſt be approved. Does the attending phyſician underſtand the nature of the water preſcribed and agreed to?—That, the populace can never hope to know. Whether he does or not, he lays down rules for the uſe of the waters. If he be thoroughly acquainted with them, and judges them proper, few or no medicines beſides are given; but the water is uſed in quantities ſufficient to produce it's natural effects. If he does not approve it; ſtill it muſt be given; at leſt, in proportions to ſwear by; ſo much, as can not poſſibly work any effect, but raiſe the patient's hope, and give the phyſician an opportunity of trying other medicines. And under this covering, the poor patient, who is made to believe, and tells you, he is actually under a proper courſe of this or the other water, ſwallows implicitely, almoſt inſenſibly, a greater number than ever of the pills and boluſes, draughts and potions, he had long taken with repugnance, or rejected before. Had not this often been the caſe, how could ſo many phyſicians and ſuch numbers of apothecaries make fortunes at Bath and other water-drinking places?—Or, how ſhould the pump room be rendered loathſom, as the ward of an hoſpital, by the diſpenſation of the medicines of numberleſs patients, as we find it at Bath and other places? What is more prepoſterous, than to ſee people cloyed with incongruous ſhop compoſitions, where they come a long journey to drink onely of a certain water?—What is more nauſeous and offenſive, than to ſee each patient come loaded with his drench of drugs; to be taken at the pump, to the great annoyance of his neighbour, if not of himſelf!—Nothing can ſurely be, but ſeeing the fair diſpenſer of the ſalutary waters

employed in mixing and giving of medicines with them! I have often reflected on the diſaſters, that may well happen at Bath upon the removal or changing of this cool and clear-headed maid, that now attends the great pump at Bath. If we ſhould ſee a leſs attentive and diſcreet ſervant in the room of this, who after the firſt viſit, knows every body, the ſize of the glaſs alotted to each perſon, and, at entrance, preſents each with, Your Grace's pills, Your Lordſhip's bolus, Your Ladyſhip's drops, Your Honor's draught, potion, powder, &c. &c. &c. What confuſion may not be induced in this important branch of Bath-practice? —I own, I have often lamented ſeeing a girl *, who might, as well as SWIFT's Stella, bring cordials in her hands and eyes, employed to ſo little good, and I may ſay to ſuch bad, purpoſes.

§ 67. The practicioner, who gives medlies of medicines, can not pretend to ſelect or point out the individual ſimple in the multitude, that produced the good or the evil effect diſcovered. And there can not be a more certain proof of ignorance, than ſuch compounding and multiplying of medicines.

§ 68. The ſame uncertainty muſt undoubtedly attend the practicioner, who preſcribes a variety of medicines with Bath or any other of the moſt powerful mineral waters: Though it be granted, he cures his patient; yet, it is in no ſenſe fair or juſt to attribute the cure to the waters, which, from their quantity, could not poſſibly produce any ſenſible effect. And, if he fails of curing, how unjuſt is it to lay the blame on the waters, which were either altered by mixtures of incongruous drugs, or not taken in a proper quantity to produce any good effect?

§ 69. To ſay nothing of patients returning from Bath, as well as other medicated waters, in a worſe ſtate than they went thither, of which multitudes are

* MOLLY LAURENCE, whoſe moſt agreeable, graceful exterior perſon gives indications of what her conduct proves, a ſenſible and well diſpoſed mind.

daily

daily ſeen every where; I have obſerved ſome coming contentedly, triumphantly home, vaunting of the ſkill of their phyſician and the extraordinary cure, through his means, wrought by the waters. Upon enquiry, and examining their voluminous collection of recipes, and the no leſs copious bills of apothecaries, a long catalogue of medicines has been given every day for ſome months, with a few ounces of the water once a day, perhaps, not above once or twice a week, during a tedious, nauſeous and expenſive courſe. Yea, I have ſeen ſome of the preſcriptions of one of the moſt famed practicioners of his time, directing a medicine to be waſhed down, twice a week, with four ounces of Bath water; where as many pounds might have been ſafely taken. But, the preſcriber himſelf, in that, as well as others of his preſcriptions, ſhewed, he knew or thought nothing of the matter, or layed no more ſtreſs upon the water, than merely to keep the patient where he reſided: For, he made Bath waters and green tea ſynonimous; bidding the patient drink four ounces of the one, or of the other. Who could refrene laughter, if the ſubject were not too ſerious?

§ 70. Such practicioners, though they ſhould vaunt of their keeping diaries of their practice ſtrictly recorded, and ſhould fill volumes with hiſtories of patients, by ſuch-like ſprinkling courſes, of theſe or any other waters, cured; offer not a mite to the funds of phyſic: Their works can authoriſe no better practice than theirs, by which they themſelves muſt have proved the greateſt gainers. And others can onely hope for ſucceſſive ignorance, or to acquire craft enough to rob time and nature of the merit of their operations, by interrupting or diſguiſing them with trifles. Theſe can never be competent judges, nor even evidence, in the cauſe of theſe waters; let them therefore reſt in peace.

§ 71. If we look into thoſe, that would paſs for rational, not empyrical practicioners, founding their prac-

practice upon the discovered principles of the waters; we shall find ourselves bewildered in a worse labyrinth, farther from the truth in all respects, than ever, if possible.

§ 72. The generality of men borrow opinions first, and then, beg or steal, if they can not themselves frame, arguments to support them afterwards. In CAMDEN's time, before philosophy brought sciences and arts to light, it was believed, that Bath waters were sulphureous. Whether they were so then, or not, is a point not now easily determined. They might, or they might not, have been such. I think, the presumption is, they have not since that time suffered any material change. Yet, since then, every writer on the subject, that I have met with, except MAYOW[a], looks upon them as sulphureous. And it is now so dangerous an heresy to glance at the contrary, that a man for hinting it, has been by some of the wise, modern, mode-led practicioners prejudged, pointed out as a fool, or a madman, without attending to, or even hearing any of his arguments! This is nothing new. It has ever been dangerous in civil, religious or physical matters to appear singular, even in the right. And with respect to this matter, they do but tread in GUIDOTT's steps, who judge "him the wisest man, "who takes things for granted, and not pragmatical-"ly contradicts the unanimous consent of judicious "writers."—This is not the onely instance, in which this man is closely adhered to by his worthy successors at Bath. Some men frame lies and tell them so often solemnly for truth, that they at length forget the falsehood and impose upon themselves. Honest, artless men, believe these lies, utter them, sometimes as their own, and then think their honor concerned in maintaining them. Sulphur being once ascribed to Bath waters, by an ignorant or designing man, the notion

[a] Tractat. Quinque Medico-physic. C. XV. De thermis Bathon. Authore JOH. MAYOW, L. L. & M. D.

was

was readily adopted, and every pretender to reasoning on the effects of the waters, attributes those effects to sulphur, which, perhaps, could not have been wrought, had they been, in his sense, actually sulphureous.

§ 73. GUIDOTT, the head of the analysers, or rational writers on these waters, asserts, that they contain, among other things, sulphur, a fixed alcali and nitre, and laughs at MAYOW, as a novel-writer, for hinting the contrary. This ingenious gentleman was put quite out of countenance and hardly ever heared of after; while the other, received more for his effrontery and confusion, than modesty and sense, has been since religiously followed by all. But, with what appearance of truth or reason, shall be pointed out in the course of this tract.

§ 74. It is not easy to reduce the Bath writers to any regular classes. One system indeed appears to predominate among all, without which, the generality might appear anomalous or hieteroclite; I mean SELF. Dear little Self! Here is the small point, which makes the head and center of all their massive works!—Compelled by hunger and request of friends is POPE's needy poet's apology for writing. We have lived to see a similar excuse made for writing on Bath waters: For, one of our latest writers sets out with telling his reader in his preface, "that he was desired "by several of his friends to examine Bath waters, and "explore their virtues, as he already had those of Bris-"tol waters."—An useful information to the public! —Two important truths brought to light! Very well; what then?—Why, after the learned Doctor had weighed and pointed out the extreme difficulty, great extent, and exceding intricacy and perplexity of the work; he generously, modestly, complied with the solicitations of his publick spirited, judicious friends; when he considered, "that he was looked upon as "qualified for such an arduous task; it being well "known, that for several years passed, he had been

"a

" a diligent enquirer into the virtues of Bath water, " and that he could not deny, what he had frequent- " ly declared as his opinion, that theſe waters ſtood " in need of ſome farther explication; and eſpecially " becauſe he now propoſed to ſpend the greater part " of the year at Bath."—What matter of joy and comfort to the public!—Has the world, or the Doctor's friends, been gratified with this much longed-for, much wanted work?—The next page of the preface anſwers the enquirer. Here, the plan is layed down, agreeable to that of the treatiſe upon Briſtol waters. He tells us, he is to begin with the hiſtory of the baths and trace them from earlieſt antiquity, to the preſent time, adjoining the medicinal hiſtory, or the opinions of antient and modern phyſicians of the uſes and virtues of the waters. In the next place, for the better aſcertaining the caſes, in which theſe waters may be found fit remedies, and that phyſicians and others at a diſtance may know where to apply for aid; the nature and cauſe of ſuch diſorders are to be enquired into and explaned. And, finally, what ſhould be the ſecond, if not the firſt, part of ſuch a work, the examining the properties and qualities of the water experimentally, by which alone their uſes and virtues can be aſcertained, is to make up the third and laſt part of the work, if ever it be publiſhed: For, the Doctor, in the concluſion tells you, " this is the method, but " not the order, in which he purpoſes to procede; " that the firſt reſpects an hiſtorian more than a phyſi- " cian; that he chooſes to begin with the ſecond " head, as more ſuitable to the ſtudy of his profeſ- " ſion."—The third it ſeems is to be left out of the queſtion; perhaps, as impertinent to the profeſſion, or to the trade, of phyſic: For, we have no more of this; our volume opens with the firſt chapter of Chronical Diſtempers in general, the ſecond, of the Scurvy, and the third and laſt of the Gout!—What may be the uſes of ſuch a book, I ſhall not attempt

to

to point out; and as for the author's intention, I muſt preſume it too obvious to all to require further illuſtration.

§ 75. To avoid tedious and diſagreeable controverſies, I ſhall neither trouble myſelf nor the readers of this tract with oppoſing, and expreſly expoſing, the endleſs errors of all the writers on this ſubject; ſuch as their talking of fermenting minerals, attributing to waters mixtures, that can not exiſt together; ſuch as ſuperabundant acids and ſulphur, with ſeveral like abſurdities; let it ſuffice, that I fairly point out what the waters appear to contain, upon accurate and fair experiments, in which theſe erroneous notions muſt appear in the true light.

I. *Of*

I. *Of the* BATHS *of* BATH.

With the moſt profound Reſpect and Veneration,
Preſented
To
The Right Honorable
The COUNTESS of ASHBROOKE.

§ 76. THE ſources of hot waters at Bath are three in number. They might be conſidered in the ſame point of view, though they have hitherto been looked upon, for the moſt part, as three different impregnations, of different qualities. And ſome have labored to make the diverſity ſtill greater, by ſubdividing them and making not onely the number, but the quality of the baths different, when the waters of one, are found to be but the overflowing of an other bath. Thus, the Baths of this city are generally reckoned ſix, to wit, 1. The King's bath; 2. The Queen's bath, which having no ſource of it's own, is but an appendage of the firſt; 3. The Croſs-bath; 4. The Hot, or as ſome chooſe to call it, the Long bath; 5. The Lazar, or Leper's bath, which is but an appendage of the fourth; and, 6. the Horſe bath, which conſiſted of the waſte waters of the firſt and ſecond. But, this has been ſo long deſtroyed, that it's place is hardly known. For greater acuracy, I ſhall confine myſelf to the three ſources, of the King's, the Croſs and the Hot baths, without regard to theſe ſubdiviſions or appendages; and after examining each water apart, ſhall then compare them to each other, and ſhew in what they reſpectively differ or agree.

§ 77. The moſt conſiderable ſource of hot water at Bath is that, called the King's bath. This ſprings

about 152 feet to the ſouth-weſt of the great church, commonly called the Abbey church, and runs, as the ground inclines, from north to ſouth.

§ 78. There are two different ſewers by which the waſte water of theſe baths is carried off: When the water riſes to the highth of four feet and an half in each bath, it overflows and runs off by certain openings, at that level. This runs by a common ſewer to the ſouthward, where it falls into the river, manifeſting itſelf by it's heat and vapor all along it's courſe. But, when the ſluices are all opened to empty the baths, this ſewer is not low enough; then, it runs in a lower channel to the eaſtward, and is diſcharged into the river, near the mill. This ſewer is greatly heated in ſome places, and, all along, emits copious hot vapors, while the baths are empty. The heat of the vapor, where it iſſues through the opening of an old vault, near the abbey-houſe, I found to raiſe the thermometer from 71 to 94. Had it been confined, the heat muſt have been greater. It riſes with a continual bubbling; ſo that when viewed in the ſun-ſhine, it appears as if numbers of little flies were playing upon the ſurface of the water; when, upon cloſer examination, theſe are found to be particules of rarefied air, with the mineral ſpirit of the water, eſcaping in ſparkles or ſmall bubbles, as the water runs into the open air. This is common to each of the other ſources, in proportion to their reſpective degrees of heat. And often, large air-bubbles riſe and fly off by uncertain intervals from and about all the ſources.

§ 79. The main ſource of the King's bath is covered over with an inverted, bell-formed, leaden ciſtern, as I am informed, with intent to reſtrain it's rapid motion, and to diſperſe it more equally to different parts of the bath, as well as to receive the pipes of ſuction of all the different pumps, which are thence ſupplied. This ſtands about the centre of the bath, where a croſs-formed, wooden building is erected with niches and ſeats for the accommodation of the bathers.

ers. The quantity of water diſcharged by this ſpring may be judged from the dimenſions of this, and the adjoining, the Queen's bath; which, though formerly diſtinct and ſeparate, now communicate with each other by an arched, open paſſage. Doctor GUIDOTT[a] tells us, that the dimenſions of the King's bath are ſixty five feet ten inches, by forty feet eight inches; and thoſe of the Queen's, twenty five feet four inches, by twenty four feet two inches. Theſe then, filled to the ordinary highth, four feet ſix inches, the former contains three hundred and fourteen tuns, thirty ſix parts of an hogſhead, which he reckons at fivety ſix gallons; the arches or niches excluded; but, three hundred and forty ſix tuns, two hogſheads and thirty ſix gallons, the niches, &c. included; the later, eighty one tuns, three hogſheads and eleven gallons; in all, three hundred and ninety five tuns, four hogſheads and three gallons, or thereabouts, without, and four hundred and twenty eight tuns, one hogſhead and forty ſeven gallons, or thereabouts, with the arches and niches. Some ſay, they contain about five hundred tuns, of which they offer no proof. This immenſe quantity of water is diſcharged from the ſource in about eleven hours; for, that is nearly the time required to fill theſe two baths; which are filled as well as diſcharged together.

§ 80. To the weſtward of this, about two hundred feet, the ſource of the Croſs bath, ſo called from a croſs erected in the center of it, riſes and is conducted in much the ſame manner. The dimenſions of this bath, according to the ſame author, are twenty four feet ſix inches in length, nineteen feet eleven inches in breadth, at the north end, and twelve feet ſeven inches, at the ſouth; which gaged at the depth of the former, four feet and an half, is found to contain fivety three tuns and forty ſeven gallons; which the ſource diſcharges in thirteen hours, being nearly the time required to fill the bath.

[a] De therm. Britannic.

§ 81.

§ 81. To the ſouthward of this, about one hundred and twenty feet, ſtands the Hot bath, ſo called from it's being found, or once deemed, the hotteſt of all. It's ſource riſes in the ſame direction, runs the ſame courſe, and is conducted in much the ſame manner, with thoſe of the preceding bath. This is of the moſt irregular figure of any. However, the ſame author gives us it's dimenſions and gage: In length, it meaſures thirty feet, eight inches and an half; in breadth, at the north end, thirteen feet, eleven inches; at the ſouth, thirteen feet, one inch and an half. It requires about eleven hours to fill it to the depth of four feet ſix inches; when, it is found to contain fivety four tuns, twenty ſeven gallons; which conſequently is the quantity diſcharged in that time. With theſe GILMORE's gage, taken in the year 1693, as mentioned by the late ingenious Mr. WOOD, nearly correſponds. But, the time, then and now, required to fill them, is found, upon the beſt obſervation of the guides, very different; each requiring a much longer ſpace to fill it now than formerly; probably, from the water's having found ſome collateral drains in tract of time.

§ 82. When theſe waters were firſt medicinally applied to internal uſes, which was about Queen ELIZABETH's regne, they had no means of getting at them, but out of the common bathing ciſtern, before the time of bathing or after. But, when they came into a more general uſe, a pile of pyramidal tubes of ſtone was placed upon the ſtrongeſt ſpring in the King's bath. This was raiſed, about a foot, above the ſurface of the higheſt water, and from a copper ſpout in it, the water was received and drank [a]. This gave way to the preſent contrivance, which was not complete, before the time of Sir ALEXANDER FRAYZER, phyſician to Charles II. 1673. To each of theſe baths, there now are different pumps for the common purpoſes, hitherto required. Firſt, a pump and a convenient, room for thoſe, who onely drink the waters;

[a] SPEED, JOHNSON, PIERCE.

others, to ſupply the bathers with the thermal water to drink in the baths, and alſo for pumping upon the different parts, required; theſe are called the wet pumps; and others, in ſmall rooms adjoining the king's bath, for pumping upon any limb or other particular part, the reſt of the body being kept covered and dry; whence, they are known by the name of the dry pumps. Of theſe, one is for men, the other ſacred to the ſex.

§ 83. I muſt, though with grief and ſhame, confeſs, that the great pools, of which I have borrowed the dimenſions and gages as above, are the principal baths of our elegant and famous city of Bath. If this tract ſhould ever fall into the hands of a foregner, I hope, it will hardly, if at all, be believed, that after the great advancements, we have made in literature and arts, in politeneſs and policy, in which we are not outdone, if equalled, by any nation upon earth; and notwithanding, the great improvements, the new lights, which philoſophy in general, phyſic in particular, in all it's branches, have confeſſedly received at our hands; ſo much barbariſm, equal to the primitive rudeneſs of Britons or Goths, ſhould be found amongſt us, as appears in the conduct of theſe abuſed baths: It is certain, they could not have been more rudely or irrationally adminiſtred in the moſt unpoliſhed ages of the Britons, Danes or Saxons, than they they are at this day. And we are aſſured by SOLINUS, who muſt have been a judge of the magnificence, as well as elegance and convenience of a bath, in which, the Romans, in his time, excelled the reſt of the world; that our baths were in a much more decent, elegant and commodious diſpoſition, in the times of the Romans, than they are now found: For, he tells us, that the hot ſprings or baths of Britain were then ſumptuouſly embelliſhed and accommodated to the uſes of mankind[a]. This ſurely, a Roman could

[a] Fonteſque calidi opiparo exculpti apparatu ad uſus mortalium. SOLIN. Polyhiſt.

not

not ſay or think of huge, rude pools, floored with a rugged pavement, ſtrewed over with looſe pebbles; ſurrounded onely with bare walls; covered onely with the canopy of heaven; conſequently, expoſed to all the changes, all the inclemencies of the air, and to the public view of the multitude. But, this alas! is the preſent, and has been long the caſe of our baths. And this no Roman, more than a modern, civiliſed Briton, can look upon, as ſumptuous, convenient, elegant, decent or rational. Of this, we have the cleareſt proofs from the ruins of the moſt curious, elegant and magnificent Roman Baths and ſudatories, which, to our ſhame, have been buried under an hateful monkiſh building, called the Abbey-houſe, and not diſcovered, till this vile ſtructure was, this year[a], removed to open the ground for another building[b]. Thus has common ſenſe and decency layen long buried at Bath. It is to be hoped, they are now upon the eve of a Reſurrection.

§ 84. The ſhameful abuſe of theſe celebrated waters muſt evedently appear upon conſidering the preſent method of bathing in Bath. In the firſt place, here are no places for undreſſing, upon going into the bath, nor for taking a bed, or for dreſſing, upon coming out. Every bather muſt then be carried undreſſed from his lodgings; muſt take his chance for the temperature of the air, as well as of that of the bath; which, from it's ſize, the time required for filling it, and it's expoſure to the variable open air, can never be determined two days, or perhaps two hours together: He muſt go in, expoſed to the eyes of the multitude, for whoſe entertainment the pump room windows overlook the king's bath, on one ſide, for the amuſement of perſons of a certain rank; whileſt the other ſides are environed with a parapet wall, by way of baluſtrade, to make a gallery for the convenience of the numberleſs ſpectators, of the loweſt claſs, who divert themſelves there with the ſight of the bathers, as at a bull or bear-beating. In this way,

[a] 1755. [b] See § 7. and following.

a poor patient muſt perambulate a pavement, more unequal than that of many of their ſtreets; in ſome places, covered with large looſe pebbles, fit for mending the high ways, by way of gravel. After wading along a conſiderable ſpace of this rugged way, which no patient can be ſuppoſed to do, without the aſſiſtance of the preſſure of the water and an attendant in the ſame attire, called a guide; thus ſupported and conducted, a perſon may paſs along, through a crowd of bathers, guides and ſpectators, of both ſexes, and of all ranks; and, when the ſeverity of the weather requires it, he may, ſometimes, ſhelter himſelf, like a ſtatue, in a nich; if he comes time enough, before they be all taken up. After making the deſtined circuit, he is conducted back to the ſlip, a narrow ſhaded place, with ſtairs, by which the bathers ſlip, or go in and out; here, he is ſtripped of his wet garb, gets on a dry flannel ſhirt, is wrapped up in blankets and ſent home in a chair to his lodgings; there, to take his bed, to cool, or to ſweat, if he can, according to the directions of his phyſician.

§ 85. In the next place, to guard againſt the inclemency of the weather, as well as to concele one's nakedneſs from the eyes of the multitude, every bather, like his attendant, is dreſſed in a tight canvaſs Jacket and Drawers, with a cap upon his head, all which he wears in coming from his lodgings to the bath. This, or any other, attire muſt help to fruſtrate the intention and the end of bathing; as the ſkin can not come freely into contact with more water, than at firſt going into the baths paſſes through and fills this garment; nor can the body with decency at any time, in the public view of bathers and ſpectators of both ſexes, nor with ſafety in the open air, at other-times, be waſhed and rubbed, as it ſhou d be to anſwer fully the purpoſes of bathing.

§ 86. In the third place, the baths can be had onely at certain hours in the forenoon; and to complete the abſurdity of the political, as well as medicinal adminiſtration of theſe baths, the patients, regardleſs of

their ranks or neceſſities, are peremptorily prohibited to bathe on ſundays; for, though the worſhipful head and members of the government never are known to refuſe to draw beer or brandy or to ſell any other of their wares on ſundays; and though every other form of medicine may be purchaſed; bathing, however neceſſary, is not to be permitted. In this reſpect, the ox or the aſs falling into a pit at Bath, is not to be helped out on the ſabbath day, to ſhew their regard to the founder of our religion, who taught the reverſe. Moreover, as bathing in one particular bath muſt neceſſarily be preſcribed to numbers of both ſexes and at the ſame time, there muſt be a promiſcuous bathing of ſexes, which decency and common ſenſe[a], as well as phyſical reaſoning, muſt condemn. The women, it is true, are cloathed. Formerly, they wore drawers, like the men; now, they wear looſe canvaſs ſhifts, girded about the waſte, or waſtecoats and ſhort pettycoats, with ſome leaden weights, to prevent their riſing with the air bubbles of the bath waters; as their female attendants or guides alſo do. In this, they ſuffer, in ſome meaſure, the ſame diſadvantages with the men. The looſer garb is certainly the better. But, the bathing of numbers together, though of either ſex, is extremely inelegant, as well as irrational. The more breathe the ſame confined air together, the worſe that air muſt neceſſarily be made. Yea, we know, that confined air, by much breathing in it, becomes, inſtead of wholeſom, noxious, to every animal. Who can be ignorant, that water ſuffers in the ſame proportion? Who is there ſo uncleanly, as to waſh his feet, or even dip his fingers, in the water uſed by another?—And ſhall perſons, of any ſenſe of elegance, decency or reaſon, go into a bath, in which, not onely the hands and feet, but the whole bodies of both ſexes, foul and diſtempered, as they may be, are at once immerged and waſhed? Sure the vile, baſe cuſtom needs no more than to be thus curſorily expoſed, to render it

[a] Aken, § 505, &c.

deteſted and avoided, as it deſerves! What a reproach is it to our phyſic and polity, that this reformation has been ſo much and ſo long wanted! That while ſome have found it their intereſt to furniſh out theatres, magnificent rooms, not equalled out of Britain, for balls, concerts, aſſemblies; in ſhort, while ample proviſion is made for all the ordinary entertainments and amuſements; there appears nothing done with a deſign to make the drinking or bathing in the waters effectual, commodious or even ſafe! For, beſides the inconveniences and the danger attending the uſe of the barbarous baths, there is not a covered way to walk in after drinking; but, patients muſt ſit or ſtand in the pump room; which, from it's ſituation, ſtructure and pavement, muſt be too hot in ſummer and as much too cold in winter. So that upon the whole, there appears no more contrivance, deſign or regularity, no more proviſion for the ſick, no more thought of ſeconding the efficacy of the waters, than if Bath had been as completely deſerted, as it is crowded by phyſicians, apothecaries and chirurgeons.

§ 87. To this, it probably may be objected, that I expoſe faults, which are not to be corrected; that they have been obſerved and animadverted upon, with due concern, by many before me; but, that no means could be found of remedying the evils. To this, I anſwer, that none evil is eaſier remedied: It is evident, that the quantity of water, diſcharged by the ſmalleſt of theſe ſources, is ſufficient to furniſh a conſiderable number of baths, great and ſmall. But, ſuppoſe there was none other ſource, than that of the King's bath, it is eaſy to calculate, from the quantity of water, by that, in a few hours diſcharged, that this alone could be made to ſupply at all hours of the day, a greater number of baths, than are generally wanting there. But, as we find, the King's bath ſource diſcharges about one thouſand and ſixty tuns in twenty four hours; that of the Croſs bath, about one hundred and ten tuns in the ſame time, and that of the hot bath, about one hundred and twelve tuns in the like ſpace, it is eaſy

to

to compute how many baths may be filled with new water in the day, allowing one tun to a Bath for a ſingle perſon. The method of diſtributing them is moſt ſimple and eaſy: It is but incloſing the great ſource, as at Aken, with a thick, ſtrong, cloſe cemented, ſtone wall, in the form of a ciſtern, of a convenient highth; arching it cloſely over, the better to confine the vapor, as well as the heat of the waters; leaving an opening, with a well adapted cover, by which the vegetable ſcum, hitherto looked upon as ſulphur, ſhould at convenient times be removed in the warm ſeaſons, when alone it riſes. From ſuch a conduit as this, it is eaſy to conceive how theſe waters, in the higheſt perfection, may be conveyed to all the lower part of the town, by pipes, or aqueducts of other kinds. If then, in the places of the preſent ſhamefully rude and barbarous baths, proper houſes were built, with all the fit accommodations for decent, regular and rational baths, as in the antient Roman baths, or thoſe of Aken; they may be ſure of a copious ſupply of water, in greater perfection, than it can now be had, as well as with Vapor baths, which are now unknown in this city. There need be no promiſcuous bathing of the ſexes; none impediment from garments; no danger of imbibing the foulneſs or diſeaſes of an other body: For, every individual, where it ſhould be found neceſſary, might have a particular private bath, as well as a bed contiguous, and all the other requiſites for bathing decently, commodiouſly, rationally and effectually. What then have been, or now are, the obſtacles to this much wanted reformation? —The Sloath, Indolence or Ignorance of thoſe, that ſhould have payed greater attention to the health of the public, committed to their care; or perhaps, the oppoſition of ſome, with whoſe private property ſuch a ſcheme might ſeem to interfere. The former obſtacles muſt be aboliſhed, as ſoon as detected. And, when we loſe that juſt ſenſe of public benevolence, which once

characteriſed the Briton, as well as the Roman, making private concerns always cede to the common good; the ſame authority, that lately aboliſhed ſome ſhameful, and deſtructive remnants of hereditary tyranny, which, in the northern parts of our dominions, had for about half a century debaſed our ſtate; ſhould be interpoſed; though in this inſtance, as in that, we ſhould be obliged to purchaſe, for the public benefit, the private intereſt of the ſelfiſh proprietors. Then, proper buildings for baths may be erected, with ſtoves and other conveniences to the eaſt, ſouth and weſt of the pump room of the king's bath, in the places of thoſe houſes, that now anoy the rude baths. Wherever the water can have a conſtant fall or quick current; there, Vapor baths may be erected, to the comfortable relief of many diſeaſes, for which no proviſion is at preſent made at Bath. The old building of every ſide the abbey church-yard, ſhould be taken down and rebuilt with contiguous porticos, with an arcade, piazza or other corridore, where the patients and others may walk in ſecurity from the inclemencies of the weather, at the water drinking hours and others. Contiguous to which, convenient retiring rooms, for the different ſexes, ſhould be provided; ſetting each part under the immediate ſuperintendance of a proper officer, who ſhould preſerve decency and regularity, and prevent offences or nuiſances of every kind. Then, might our BATH excell all others in elegance and convenience, as far as our BRITAIN outdoes the reſt of the globe.

II. *Of*

II. *Of the Nature and Qualities of the ſeveral* WATERS.

As a ſmall Teſtimony
Of the utmoſt Reſpect and Gratitude,
Due to the beſt of PATRONESSES and FRIENDS;
Moſt Humbly offered
To
The RIGHT HONORABLE
The COUNTESS of MEATH.

§ 88. 1. NOW, to return to the view the of water.—As it ſprings, or is drawn by any of the pumps, the water of each of the ſources appears quite colorleſs and very clear; but, upon a cloſer examination, in a glaſs, ſome minute, white molecules, like thoſe obſerved in Aken baths, appear aflote in it. At pumping, it ſparkles in the glaſs, by ſeveral ſmall air bubbles flying off. Upon ſtanding in the open air, it abates of it's pellucidity, as it cools; and in ſome hours, gets a kind of milky or rather a whea-like aſpect, as it ſhews in the baths; and depoſites a pale yellow, or ochrous ſediment, which falling upon linen, ſtains it yellow, or in the vulgar phraſe, makes iron-moles. Kept cloſe ſtopped, the change of pellucidity is leſs ſenſible. Theſe circumſtances are common to the three ſources.

§ 89. 2. The water newly drawn, or taken up as near the ſource as may be, has no ſenſible ſmell, no more has it's vapor; though from the bath, while it is filling, and ſoon after it is emptied, the acid ſmell of the pyrite may ſometimes be perceived; without any of the fetid ſmell, neceſſarily attending waters in any

any manner impregnated with ſulphur and heated. This circumſtance, in which all the ſources agree, firſt raiſed in me the doubt of the exiſtence of ſulphur in theſe waters, to which I ſhould not however have given way, had I not found the teſtimony of the ſenſes, confirmed by other concurring experiments.

§ 90. 3. In the taſte, theſe waters all agree.[a] It is not eaſy to deſcribe the ſenſe, they imprint upon the palate: They appear to me to be ſlightly ſaline, ſomewhat bitteriſh, and vitriolic or ferrugineous; which laſt flavor vaniſhes upon, or ſoon after, the cooling of the waters. Such are the proportions of the ingredients, that theſe waters are far from diſagreeable to the palate.

§ 91. 4. To the touch, they all feel hot, at flowing, even in the ſummer; but, ſeem more ſo in winter; though I can not find, nor apprehend, that they undergo any ſenſible variation from the changes of the atmoſphere, till they are diſcharged from under ground. Examined by Farhenheit's thermometer[a], I found their reſpective heats, as follows, without any ſenſible variation, upon the mercury's ſtanding in the atmoſphere at the different points between 72 and 83.

§ 92. 5. The King's bath water in the pump room, after the pump had been as much heated by continual pumping of the hot water, as it ever is; raiſed the quickſilver in the Engliſh thermometer to 119. which I take to be equal to the like number of the Dutch thermometer. By that in the Bath, it was raiſed to 120.

§ 93. 6. The water of the Croſs bath pump, after the like continual pumping, raiſed the quickſilver to 114 of the ſame thermometer.

§ 94. 7. The Hot bath, after the like continued

[a] In comparing theſe thermometrical trials with thoſe at Aken, it muſt be remembered, that I uſed a thermometer of Farrenheit's making there, and one of Heath and Wing's, a ſcale of the ſame dimenſions, and diviſions here.

pumping,

pumping, the water at the pump raiſed the quickſilver to 119, of the ſame thermometer.

§ 95. 8. Not contented with examining their heats as they were diſcharged at the ſeveral pumps, I thought it right to examine them ſeverally as near their reſpective ſources, as I could come. For this purpoſe, I went into each bath, when empty, and meaſured the heat there, which I found as follows;

§ 96. 9. The hotteſt current iſſuing from the ſource of the King's bath, when empty, did not raiſe the quickſilver above, that of the pump, 119.

§ 97. 10. But the pump in the bath, next to the ſource, raiſed it to 120.

§ 98. 11. The hotteſt current from the ſource of the Croſs-bath raiſed it to 116.

§ 99. 12. And the pump in the bath to the ſame degree, 116.

§ 100. 13. The hotteſt current, I could find from the ſource of the Hot bath, as it is called, did not ſenſibly excede the heat of the water, raiſed in the pump-room; both alike raiſed the quickſilver to 119½. But this ſeemed at ſometimes rather higher, by about a quarter of a degree; hardly ever more, that I could find.

§ 101. 14. Thus, the water of the hot bath is found actually the hotteſt at the pump, by half a degree, whence perhaps it might have got it's name. The King's bath is half a degree leſs hot, at the pump in the pump-room; owing probably to it's diſtance from the ſource; but, it appeared to me half a degree hotter at the pump, next the ſource in the bath. And the Croſs bath is leſs hot than either, by above five degrees, at the pump in the drinking room, and above three degrees at the pump in the bath. As the coldeſt of theſe ſprings affords water heated above twenty degrees higher than human blood in the ordinary healthful ſtate, it it eaſy to conceive the conveniencies and advantages, which theſe ſources, under a regular oeconomy, might afford.

§ 102.

§ 102. 15. The weighing the waters helps our judgement ſomewhat in this matter.

	ounc.
§ 103. 16. Thus, the phial, in which the ſimple waters were weighed,[a] filled with the water of the King's bath in the pump-room, weighed - -	4. 6. 0. 12.
The ſame cold - - - - - - -	4. 6. 0. 16.
§ 104. 17. The ſame phial, in like manner, filled at the Croſs-bath[b] pump, weighed - - - - - - - - -	4. 6. 0. 16.
The ſame cold - - - - - - -	4. 6. 0. 16.
§ 105. 18. The ſame phial, in like manner, filled at the Hot-bath[c] pump, weighed - - - - - - - - -	4. 6. 0. 11¾
The ſame cold - - - - - - -	4. 6. 0. 16.

§ 106. It is not to be imagined, that the waters, as they lye in the baths, will ſtand theſe teſts: There, they are affected by the variations of the atmoſphere; ſo that there can be nothing determined with certainty in this reſpect, without examining them before they can thus, or otherwiſe, be ſenſibly altered. For, in the open air, they loſe not onely heat, but their moſt volatile parts.

§ 107. As ſoon as the bathing is over, the waters of the ſeveral baths are diſcharged, by the opening of ſluices, made for that purpoſe. Then, each bath being emptied, the ſluice is cloſed, and all the waters collected for the ſucceeding days bathing. The water, which at firſt running from the ſource, appears very bright, as before obſerved[d]; ſoon begins to ſhew it's ſelf turbid, muddy, and of a yellowiſh, or pale lute color; ſo that the bottom of the bath can hardly be ſeen through two or three feet depth of water. Thus, the water ſuffers a conſiderable decompoſition: For, the terrene parts diſſolved and ſuſpended in it, by the means of a mineral acid ſpirit, as ſhall be hereafter ſhewn, and that of heat; as theſe eſcape or decline, the more heavy parts

[a] § 42. § 92. 5. [b] § 93. 6. [c] § 94. 7. [d] § 88. 1.

pre-

preponderate. Hence, the waters depoſite a pale ochrous earth, which may be collected in the ſewers, that carry off the waſte waters of each bath. This appears on the bath walls below the high water mark every where.

§ 108. What the waters carry with them, whether ſuſpended or diſſolved, give the beſt indications, whence they deduce their origine; as the qualities of all waters depend upon the bodies, through which they paſs, or upon which they lye: For, if ſuch bodies be ſoluble in water, that which comes into contact, muſt be impregnated with them; if inſoluble, the water remanes unaffected, or ſimple.

§ 109. Beſides what is diſſolved in bath waters, they bring with them and throw up at their ſprings, two bodies of different natures and qualities; as yet, but very little known, though evident to the ſenſes of the meaneſt naturaliſt.

§ 110. The firſt is a mineral ſubſtance, in the form of ſand, paſſing for ſuch with all ſuperficial examiners. This is that body, which heats and impregnates the waters; and therefore, the knowledge of it is fundamentally neceſſary to every rational enquirer into the nature and qualities of theſe baths. This ſand-like ſubſtance is found under the inverted ciſterns, that cover the ſources. It appears of an aſh-color, when wet; dried, it looks like a light grey ſand, at firſt ſight; but, upon a cloſer view, it is found to conſiſt of little cryſtals, like thoſe of which common ſand is compoſed; ſome colorleſs, others of different ſhades of yellow; ſome terrene opac particules, which appear to be free-ſtone, and ſome dark colored earth, mixed with ſome glittering ſparks of a metallic matter.

§ 111. 1. To the taſte, this ſubſtance is purely ferrugineous, and being waſhed with warm, or even cold water, imparts it's martial quality to it, renders it, what we commonly call, chalybeate; for, it ſtrikes a fair blew, with infuſion of log wood, and a beautiful purple, with that of galls.

§ 112.

§ 112. 2. It cauſes an ebullition and efferveſcence, diſcharging a ſharp, ſulphureous vapor, with the mineral acids; and ſome conflict upon mixture with the vegetable acids.

§ 113. 3. Thrown into an ignited crucible, it emits a ſtrong ſulphureous vapor, and a blew flame, ſuddenly diſappearing; ſo that it is hardly perceptible to the ſight: The vapor collected in a glaſs bell, condenſes, and ſhews itſelf to have been none other, than the univerſal or vitriolic acid.

§ 114. 4. The reſiduum, calcined till it ceaſes fuming, changes color to ſome degree of brownneſs; and then being moved to the magnet, ſome particules of iron are attracted from the maſs. The reſt waſhed, give more proofs of lime, than metal.

§ 115. From experiments of this nature [a], ſome would draw arguments to prove an alcaline principle and brimſtone, as well as iron, in this ſand-like ſubſtance, and conſequently in the waters. But, they greatly deceive themſelves; for, what paſſes with them for an alcaline principle, is but an abſorbent earth; probably, either from a calcarious, or a ſparry ſtone; which, with their brimſtone and iron, conſtitutes a perfect pyrite [b], the cauſe of the heat and impregnation of theſe and all ſuch like waters.

§ 116. That this long-unknown ſand is none other than a pyrite, reduced to this form, may be further proved by taking any ſimple, marital pyrite, wetting it often, expoſed to the air, then waſhing it. The water, with which it is waſhed, will be charged with the acid and the iron; and if there be a ſufficient quantity of that metal, will give green coperoſe, or martial vitriol. In this, we have one of the principles of ſulphur, the acid, united and ſaturated with iron, the other, the phlogiſton, the moſt inconſiderable in quantity, by great odds, being onely as about one to fiveteen, and the moſt volatile, having made it's eſcape in the decom-

[a] § 112. 2. § 113. 3. [b] See Aken, § 73. 2. § 359 and foll.

poſition

poſition of the pyrite. And thus, the pyrite decompoſed, gives a vitriolic, but not a ſulphureous water; and when it has been by this means comminuted and waſhed, it will be found to afford a ſubſtance ſo exactly agreeing in form and qualities with this hitherto-myſterious bath ſand, that not one of the diſpenſers of brimſtone at Bath ſhall be able to diſtinguiſh the one from the other. If any heſitate in doubt about this truth, let them examine any of the coperoſe works in this kingdom, or in any other, where green coperoſe is made from a martial pyrite, without calcination. There, theſe appearances, and a vitriolic, not a ſulphureous water, are always found. From this pyrite then, and this alone, I preſume to deduce the heat and compoſition of the waters of Bath, Aken, and other baths, whether ſimple or medicated; upon the principles above cited[a]. But, as as I pay none implicite faith to any man, in religious or political, much leſs in phyſical matters; ſo I neither demand nor deſire to accept of any. When truth is made evident, it muſt prevale. Let experiments then, and facts be our guides.

§ 117. Bath waters in their courſe bring another ſubſtance with them, which has cauſed great ſpeculation, without coming at the truth; and has hitherto ſerved onely for a ſanction for the ignorant or deſigning to attribute ſulphur to theſe waters. I mean, a ſcum, that riſes on the waters, more or leſs, according to the moiſture and warmth of the ſeaſon; and never at any other time than the months of May, June, July, Auguſt, or September, in any quantity. It appears of a dark brown, or olive color, but being cloſely examined, proves to be of a very deep green. It is obſerved floting on the baths in greater or leſs glebes, of a ſmooth, ſoft, gelatinous conſiſtency, mixed with the common, ferrugineous ſcum of the baths. It is diligently ſcummed off, before the bathers enter the baths; though during the time of

[a] Aken, § 73. 2. § 359, 360, 361. and foll.

bathing,

bathing, ſome portions of it often riſe with the waters. This has been formerly looked upon as a bitumen; but, as it was found, in proceſs of time, to have no relation to that ſubſtance; which is either liquid, and ſticks to any dry body, that touches it, as oil or fat does; or is conſiſtent and dry, but melts or ſoftens by heat, ſo as to ſtick, like reſin or pitch, to the hands of thoſe, that handle it; this name was changed for another, no leſs improper and unjuſt; which notwithſtanding, now univerſally obtains; I mean that of ſulphur; for, this ſubſtance is called, known, and preſcribed by the name of Bath ſulphur; nor is it yet known by any other appellation, that I can learn.

§ 118. Before I had viſited Bath,[a] from all the writers on that ſubject, and the travellers, I had met with, I was perſuaded, theſe waters afforded ſulphur, as plentifully as thoſe of Aken. Having heared much of this ſulphur, it was one of the firſt things I ſought. In taking my ſurvey of theſe waters, this was one of the firſt remarkable matters, that preſented itſelf to my view. I could not be a ſtranger to a body, I had ſo often ſeen, upon the ſurface, as well as at the bottom, of ſhallow ſtagnant waters; that I do not remember a ditch or pond of ſuch water, of two years ſtanding, any where, free from this production, in the ſame ſeaſons, in which it is found at Bath. My firſt ſurpriſe was, how it came there; but my greateſt aſtoniſhment was, to find, it paſſed with all the authors, and all the inhabitants of the city, and all the phyſical fraternity, from the higheſt to the loweſt, that I ſaw or heared of, except one, for either actual ſulphur, or a ſulphureous or bituminous, or bituminoſo-ſulphureous ſubſtance.

§ 119. Various arguments were by ſome offered to prove this ſubject ſulphureous, or partaking of ſulphur or bitumen, in oppoſition to mine aſſerting the contrary, as I, ſoon after ſeeing it, did publicly. Though their reaſoning was not abſolutely concluſive, I began to ſuſpect, I had been miſtaken, and that we

[a] In the year 1753.

meaned

meaned different things. Upon which, I was deſired to call to any of the guides for Bath Sulphur, as they, who were accuſtomed to collect, and apply it to the patients, would undoubtedly give me the right ſort. Having thus had recourſe to the guides, for greater certainty, I readily procured ſome ſpecimens of this Bath ſulphur, which were approved to be right, by thoſe, that put me in this method of procuring it. But, I was not at all undeceived. I was now onely certified, what it was, that had been thus taken for ſulphur, which was onely what I had before obſerved and collected my ſelf, a fair vegetable, a minute aquatic plant, which, though evident to the ſenſes of ſight, touch and ſmell, Mr. THOMAS HAVILAND, the apothecary, of all that I converſed with, or heared of, at Bath, was the onely perſon, I met, ſkilful enough in Botany to perceive it to be but an aquatic plant!

§ 120. 1. I took of this ſubſtance, which ſmelled like others of it's tribe, and had a ferrugineous taſte, from the chalybeate ſcum of the water, which aroſe and mixed with this minute vegetable, ſo that the one could not be well gathered without the other; I waſhed off the mud, that adhered to it, and could then diſtinctly ſee it's minute, more than capillary, ſtalks, or fibres, like ſhreds of a fine deep green ſilk, and ſhewed them to ſeveral others. Mr. WOULFE, a moſt ingenious naturaliſt and chemiſt, who aſſiſted me in mine experiments then at Bath, and Mr. VAUGHAN the chirurgeon, obſerved the ſame. It anſwered all the characteriſtics of the ſmall aquatic plants before mentioned, under the titule of Alga or Conferva[a].

§ 121. But, ſuppoſing, to gratify the Bath advocates for brimſtone, that this is actual bitumen or ſulphur; Does it thence follow, that the waters are therewith impregnated? No certainly: For, till it appears, that ſimple water, or what is a more unfit ſolvent, water, by the means of an acid, charged with various

[a] Aken, § 108. 18.

minerals; can diſſolve ſulphur; though actual ſulphur were gathered on the ſurface, or found at the bottom, of ſuch waters, they are not to be demonſtrated, nor even preſumed, to be ſulphureous.

§ 122. But, that I may not myſelf be deceived, or impoſe upon others, by appearances, I put this ſubject to the common chemical teſts.

§ 123. 2. I dried this ſubſtance ſlowly in the ſhade, then committed it to a retort, and having adapted a convenient recipient, and luted the junctures; I deſtilled it in a fire gradually raiſed, till it ceaſed yielding any drops or fumes, in an increaſed heat. It yielded a ſubacid phlegm, and ſome empyreumatic oil, like other vegetables of the ſame claſs; without the leſt appearance of any concrete like ſulphur, more than bread in the like treatment would have yielded. In the recipient, remaned a black coaly ſubſtance, which burned to a white aſhes, in an open fire, and gave a ſmall quantity of a fixed alcaline ſalt by elixiviation and evaporation; as moſt vegetables do. And in the whole, yielded nothing like ſulphur or a ſulphureous body. Moreover,

§ 124. 3. The dried plant thrown upon live coals, or a well ignited iron, gives a ſharp, thick fume, and a pale blaze, which no more reſemble thoſe of ſulphur, than thoſe that iſſue from aſh or oak, upon the like treatment, are found to do. In ſhort, the ſmoak and flame correſpond with thoſe of all this tribe, and differ not in appearance from turf or peat. Compare this with the characteriſtics of ſulphur, Aken, § 77. 2.

§ 125. As theſe experiments fairly acquit this production from the groundleſs imputation of being bitumen or ſulphur, or ſulphureous or bituminous, it can not be thought by any means, to tend to impart the qualities of bitumen or ſulphur to theſe waters, though it may ſerve to help us to conceive whence, theſe heated ſprings deduce their origine. But, firſt let it be obſerved, that this, like other ſmall aquatic plants, is very liable

to

to putrefaction: ſet in an heap in a warm place, it putrifies in a few days, and in ſome time is reduced to a black, ſoft mud or earth. While it continues in a ſtate of putrefaction, and for ſome time after, it emits an offenſive, putrid ſmell, and tarniſhes ſilver of a fair yellow hue. When then, this weed has been detained for any length of time in it's paſſage, or in the ciſtern, it might have given theſe qualities to the waters in ſome degree; but then this is not continual; it is quite accidental, and has been but very rare. It is then to be imputed onely to the obſtruction or detenſion of this putrifying weed in it's paſſage. How far this relates to ſulphur, or to the waters, is eaſily judged from the premiſes. Had the pretending analyſers mentioned, and been deceived with, this; I had not blamed them much. But, never glancing at this, nothing but corporeal ſulphur could ſerve their purpoſes; for which, they catch even at this little weed, which proves to them no better than a broken reed. Now, to endeavor to explane whence comes this ſcum.

§ 126. It has been already ſhewn, that all waters, found in or upon any part of the globe, ſometime, in ſome place, waſhed it's ſurface; and however compound ſuch waters may now be found, they were originally, or at ſome time, ſimple; till they were diverſly impregnated in their paſſage, through the atmoſphere or the earth, with ſuch things, as water is capable of diſſolving. The origine of every ſpring may be looked upon to be in the clouds; but, the reſervoir, that feeds it and gives it a conſtant uniform current, muſt be placed upon the earth, or under it's ſurface.

§ 127. Now, we have no proof of theſe like aquatic, nor indeed any other, plants vegetating deep under ground. Yet, we find, not onely this little aquatic vegetable, but ſome of the product of the foreſt, ſuch as nut-ſhells and entire nuts of the hazel tree, the one partly aflote on the baths, at certain ſeaſons, and partly reduced by putrefaction, to a black mud or earth, the one detained with the other, in the ciſterns.

§ 128. There can be no doubt then, that theſe ſubſtances were produced in the open air, upon the ſurface of the earth. The firſt floting entire and perfect, ſhews it has not been long enough, to ſuffer any martial change, in it's paſſage from the place of it's growth to the bath; which argues it, therefore, produced at no great diſtance; to confirm which, it's appearing on the baths, when it is common on every ſhallow pond or ditch in the neighbourhood, and then onely, contributes; as it likewiſe does to ſhew, that this is not a mineral production; becauſe. had it been, as is vanely imagined, bitumen, ſulphur, ot any other mineral body, it muſt be found alike common in all ſeaſons of the year; the contrary of which is, by experience proved. From theſe conſiderations, it is natural to conjecture, that the hot ſprings at Bath are partly ſupplied from ſome of the ſhallow ponds, and ſlow running ſprings and rivulets in the neighbourhood; from the coppice or hedges, about which, the leaves and nuts of trees may be, by the ſame ſubterranean conveyance, carried. Though it is not to be denied, that a great part of it grows upon the bottom of the baths themſelves, for want of ſufficient cleaning. Theſe waters, paſſing through the lower part of a bed of heated or ignited, conſequently decompoſed, pyrite; and there, contracting the heat and the impregnation they receive, may be eaſily conceived. Had they paſſed over this bed, they might have caught the more ſubtil and volatile parts of the decompoſing pyrites onely; whereas, they are found charged chiefly with the more groſs and terrene parts. The light black mud or earth, that is found moſtly in the ciſterns, but partly depoſited by the waters in the corners of the baths, that eſcape cleaning, is no more, than ſome of theſe like vegetable productions, which have undergone a kind of putrefaction. This appears, 1. from it's fetid ſmell, and, 2. from it's tarniſhing ſilver yellow and black; properties of all putrid vegetables. But, that it is not of the mineral kingdom, is evident, 3. from

it's putrifying, which minerals do not; 4. from it's burning like a vegetable, with no fume or flame like ſulphur; and 5. from it's yielding nothing like ſulphur in ſublimation or deſtillation.

§ 129. Having thus ſeen what the waters carry with them undiſſolved; let us examine what they contain diſſolved and united with them. I ſhall ſet out at the King's bath pump room, and afterwards take in the other ſources.

§ 130. 1. The firſt thing remarkable, that preſents it ſelf to our obſervation in this water, is a ſubtil acid, which flies off in the vapor, ſometimes ſenſibly ſtrikes the noſe, always proves very offenſive to weak lungs, and powerfully corrodes all the iron works in and about the Baths. This is continually flying off the water in the open air; whence, upon it's loſs, it becomes turbid. It ſo far eſcapes in the cloſeſt corking, that ſome precipitation, chiefly of martial earth, is formed, by the time the water becomes cold, and it's gall-tinging quality is ſenſibly abated, if not entirely loſſed. Therefore, ſuch as would uſe this water in perfection, ſhould have it as near the ſource, as ſhort a time detained from it, and as little expoſed to the air, as poſſible; for reaſons, which will further appear upon ſucceding experiments.

§ 131. In order to ſee the changes wrought in this water, upon drawing and keeping it ſometime from the ſource; I filled bottles with it at night. Some of theſe, I left open; others, I corked with care, and let them ſtand to cool for mine experiments the next morning. By cold corked, in the following compariſons, I ſhall underſtand the water, with which bottles were filled, then carefully corked and ſet ſtanding to cool; and by cold open, that, that lay in the ſame place, in open bottles to cool.

§ 132. As Bath water has always been deemed ſulphureous[a], by all the writers and practicioners of our

[a] See a juſt exception to this, in the note upon § 277. following.

country, that I have converſed with, as well as by ſome foregne authors [a], who copied from them; the firſt thing my curioſity prompted me to ſeek for, was ſulphur. Of this, I found no marks, no traces in the vapor or ſmell, as before obſerved [b]; nor by any other experiment. But, as I am ſingular, it may yet be preſumed, I have not hit upon the right method of diſcovering it.—Read on and judge.

§ 133. The firſt trial, to which I had recourſe, was the trite, though incertain experiment, of holding a piece of clean ſilver in the thermal water. The gilding of ſilver ſhillings to the color of golden guineas, by Bath water, was ſo univerſally aſſerted and believed, that it would have been conſtrued madneſs, or folly in extremes, as it has ſince been, to call it in queſtion, or even to repete the well known experiment; as every body, that had ever viſited Bath, was ready to atteſt the fact, by producing ſuch gilded ſhillings, which had obtained the name of Bath guineas.

§ 134. It is certain, all ſolutions of ſulphur in water, or watery liquors, which can by no known means be made, but that of lime or alcaline ſalts, either fixed or volatile; all ſuch ſolutions, and all impregnations of water with the eſſential principles of ſulphur, the univerſal acid and phlogiſton, will tinge plate ſilver of a golden color firſt, and then to various ſhades of orange, red, blue, purple and black; and precipitate ſolutions of lead and ſilver of a dark yellow, brown, or muddy color, inſtead of white; as obſerved of the volatile principles of Aken water [c].

§ 135. But, this is not to be attributed to ſulphur or common brimſtone onely; it is owing to the detached or diſengaged phlogiſton or inflammable principle alone, and that of any body, whether of the animal or vegetable, as well as of the mineral kingdom, will always produce the ſame effect. To be more explicit, though prolix: There is no water

[a] BERGER, HOFFMAN, tracts cited. [b] § 89. 2.
[c] Aken, § 189. 1. and following.

without

without more or leſs of an oily ſubſtance[a]. This makes it ſubject to putrefaction, which cauſes a decompoſition of this oily ſubſtance, and ſets the ſubtil phlogiſton at liberty. This makes putrifying waters ſtink and tarniſh ſilver; as is experienced in the bilge-waters and others on board ſhips, and wherever ſtrongly putrified water is found. I conceive the air, charged with this ſubtiliſed oily matter; whence, vegetables as well as animals inſpire it, and thence become oily or fat. With the air, it mixes with water, by which it is abſorbed and retained, and is probably one of the principal nutritious matters in water. It is probably this oily ſubſtance chiefly, that putrifies in confined air; where it produces the effects of putrefaction, and cauſes ſome kinds of thoſe vapors, which our miners call damps. The ſeveral bodies of the vegetable and animal kingdoms are ſubject to putrefaction, in which all bodies are reduced to their firſt principles, which, being thus diſengaged from each other, act according to the laws of affinity or attraction. Of theſe principles, the inflammable, as the moſt ſubtil and volatile, eſcapes firſt; and, among other effects, manifeſts itſelf in the ſmell, ſticks in the pores of ſilver and gives it a golden color, &c. Before this principle is ſet at liberty, by breaking, in ſome ſort, it's connection with the univerſal acid in ſulphur, which is effected by the interpoſition of lime and alcalies, or ſuch matters as abſorb or overcome the acid, with which it is found, in other inſtances, to have the ſtrongeſt attraction or affinity; ſulphur alone is not found to gild ſilver or tinge it yellow; but, as ſoon as the union of the acid and the phlogiſton in the ſulphur is broken, and a ſolution of ſulphur is made, by lime or alcalies, then the diſengaged phlogiſton in this, as well as in other bodies, flies off, ſtrikes the ſenſe of ſmelling with a putrid ſtench, tinges and tarniſhes ſilver, &c.

[a] See part I. London waters. § 278. 7. § 283. 3. § 285. 5. § 291. § 305. 309. 4. and following §.

§ 136. That here is a perfect decompoſition of ſulphur is evident from this; that without adding an acid, ſuch a ſolution cannot be revived into ſulphur; whereas, upon reſtoring what the alcali deſtroyed, an acid; all ſuch ſolutions yield a precipitate of ſulphur. And an inconteſtable argument, that the phlogiſton is totally diſengaged from the acid by an alcaline ſolution, is this, that expoſed to the fire, no ſulphur ſublimes; but the phlogiſton, in it's own proper form, eſcapes; which it likewiſe does by time in the open air, leaving a neuter ſalt, compoſed of the acid baſis of the ſulphur and the alcaline ſalt, behind.

§ 137. From theſe conſiderations, it appears, that it is not the concrete, ſulphur, but one of it's principles, the inflammable, that produces the change in ſilver; and that this is produced in like manner, by all bodies, from which this principle is, in this form, detached: Thus, putrifying bodies of all kinds, excrements of animals, jakes and ſewers in cities, bilge and other putrifyed waters in ſhips, &c. produce this effect; without being to be deemed, from this circumſtance alone, ſulphureous. Thus, likewiſe, the yelk of an egg, boiled or roaſted hard, tinges ſilver firſt yellow, and then tarniſhes it further, without bearing any relation to brimſtone.

§ 138. Now, let us ſee what clame Bath water has to ſulphur, or to the inflammable principle. — As I ſtand ſingle, having but the exploded MAYOW[a], and even him, but faintly on my ſide; and as I find myſelf powerfully oppoſed, not to ſay abuſed, by ſome of the faculty, particularly at Bath, where they ſeem to think their reputations, as well as their idol, in ſome danger, and have written letters to ſome of their brethren in town, contradicting what I ſayed and demonſtrated, in my chemical lectures upon this head; under ſuch circumſtances, it may be imprudent, if not dangerous, to deny the exiſtence of ſulphur in the waters of Bath, upheld by ſuch a formidable train of ſatelites,

[a] Tract. cited,

as

as ſhine refulgent in light, borrowed from their primary, gawdy planet.—Truth muſt be bold. And he, who is inured to ſuffering the worſt evils, that the wickedeſt men in power could inflict, for the cauſe of truth, can not be diſmayed at the puiſnee threats or anathemas of the leſſer factions in a diſtempered ſtate. Let then facts ſpeak for themſelves;

§ 139. 1. A clean ſilver ſpoon, ſtanding ſome hours in the water, ſhewed not the leſt viſible tendency to yellow. The ſame experiment, tried at the pump, under a continual current of hot water, had no better ſucceſs. Then, clean ſilver leaf, beat out of coppelled ſilver, was ſet in a large glaſs, and filled with water from the pump; where it was kept for eight hours, firſt, the water often renewed, without any ſenſible change; and then, for twenty four hours, in the like manner, without inclining perceptibly to any ſhade of yellow. I repeted theſe experiments ſeveral times, to no better effect; and at length, preſumed to conclude, in mine own mind, with great ſubmiſſion to theſe potent diſpenſers of fire and brimſtone, and all ſelf-ſufficient dictators, that they were all, in this at leſt, miſtaken.

§ 140. Being by repeted, accurate trials, aſſured of the truth of mine experiments, I ventured to mention their reſult publicly; when, I received for anſwer from ſome, "that the exiſtence of ſulphur was too well atteſted, by the authority of antient and modern writers and practicioners, to admit of any doubt at this day; that the fact was known to the guides or attendants of the baths, and that if I gave any of them ſome ſhillings, they would ſoon bring them to me tinged, as if gilded, ſo that they might paſs for guineas." The firſt part of the anſwer could have had no weight with a man void of implicit faith; but, I judged it fit to put the other parts to the teſt; and for that purpoſe, gave one of the guides ſome ſhillings, which he ſoon returned to me of a clean, bright, pale guinea color. The fact was not to be denied, and the gainſayer muſt be a fool in common eſtimation. But, how this was done

now

now remaned to be ſhewn. It was firſt ſayed to be done by the bath-water. But, that being denied, as planely impoſſible, with a boldneſs, that ſavored more of truth than diſcretion; the waters and mud were then ſayed to be both neceſſary. Upon deſiring then, to ſee the gilding thus performed; it was at firſt evaded, and at length poſitively refuſed; being, as as was alleged, a ſecret of great import.

§ 141. I now ſaw the fraud clearly; for, if the Bath waters, mud, or any thing elſe, properly belonging to the baths, were really concerned in this pretended gilding or tinging of ſilver, why ſhould it not be done as openly and publicly, as the matter was by all ranks aſſerted for a fact? — It will not be unpardonable to confeſs, that I now, more than ever, ſuſpected an impoſture, ſomewhere; and that I began to be aſtoniſhed, at finding phyſicians, or reputed phyſicians, either ignorant of, or conniving at, the fraud; but, which, I ſhall not dare to determine.

§ 142. I could not be inſenſible of the various ways of tinging ſilver yellow. I readily and clearly ſaw, this was neither really gilded nor lacquered, but actually tinged, as in ſome ſuch ſolution of a phlogiſtic body, as we have before mentioned [a]. Deſirous to come at the truth, I was obliged to fall in with the too univerſal mode, and bribe the under-prieſt of the myſteries, onely to let me ſee his operation.

§ 143. He pretended artfully, that the mud of the baths, was what, by a peculiar management, known onely to a few of his brethren, by which, I hope, he meaned onely the guides, produced the golden effect. I ſaw him collect the mud and attended him to his own houſe; where I found his wife was the more dextrous in the fraudulent operation. Having firſt ſcoured well the pieces to be gilded, with fine ſand, this Deaconeſs of the myſtic rites of impoſture poured ſome hot-water out of a kettle upon the mud in an earthen ba-

[a] 134 to 136.

ſon.

ſon. Into this mixture, ſhe threw the ſcoured ſhillings and rubbed them in it, with her fingers; but, without producing any ſenſible effect.— Then, ſhe took up a quart bottle and poured a little of it's liquid contents into the muddy mixture; upon which, the ſhillings began to change their aſpect and turn yellow; ſhe continued rubbing them, now and then adding ſome of the liquor in the bottle: till ſhe brought them to the deſired color; then ſhe waſhed them ſlightly, with the warm water, and dried them. Thus was the ſilver evidently tinged of a golden color. Who can deny it's being done at Bath and by Bath water? None certainly, but thoſe, who take nothing upon truſt, in phyſical matters eſpecially; and who are duly qualified for making experiments, with their own proper hands, in every branch of their profeſſion.

§ 144. I muſt have wanted the ſenſe of ſmelling, as well as be void of all knowledge in chemiſtry, did I not diſcover this ſecret, at ſight and ſmell of the operation. I took another clean ſhilling and ſhewed them, they need not be at that trouble; ſince, what was in the bottle alone was ſufficient for the purpoſe; ſo pouring a little of the ſecret, odoriferous juice upon this cleaned ſhilling, tinged it inſtantly, as deep, though not as equal, as thoſe, that were rubbed with the mud. Shall I be believed, when I aſſert any thing contrary to long-eſtabliſhed doctrines? againſt the united teſtimony of the faculty of phyſic in all it's branches, even down to the guides and nurſes, at Bath?—It is hardly to be expected. Yet, am I hardy enough to aſſert, that neither Bath water, nor any thing that enters it's compoſition, is concerned in this operation, which is performed by, what offends the ſenſes, even at naming, putrid urine onely, without any thing related to theſe baths.

§ 145. Hence, it is plane, theſe waters are in no ſenſe ſulphureous. It is alſo plane, that even the guides muſt have known it to be ſo; when they learned, that theſe alone were inſufficient to tinge the ſilver.

What

What then ſhall I ſay to the phyſicians?—They have long unanimouſly aſſerted and agreed, that theſe waters are ſulphureous! — Upon what authority? — Have they always been, and do they ſtill remane, ignorant of the truth? — This would be an unpardonable, an indelible reproach. It is not therefore to be preſumed. Or, do they know this to be a baſe and ſcandalous fraud, long impoſed upon the world, and ſtill connive at it? Forbid it heaven! For, that would be a crime, of a ſtill deeper dye. I am ſorry, I can not find ſome apology for them. Happily they are of age; let them then anſwer for themſelves.

§ 146. As I ever judged it beneath the dignity of a public-ſpirited man, I kept none experiment or diſcovery, I made in any of theſe like reſearches, at Aken, Spa, Bath, or elſewhere, a ſecret; but, as a lover of truth and mankind ſhould, declared the reſult of every material experiment and obſervation, I made; and often publicly repeted them, for the ſatisfaction of others. I met the return, to be generally expected from the multitude: A certain Walloon licentiate[a]; before whom, upon the recommendation of the late famous Doctor REGA of Louvain, I made many experiments, which I dictated and explaned to him, as he thought it fit to record them; as ſoon as I left the city, this gentleman began to ſhew ſuch of theſe experiments, as he was capable of comprehending, as his own, and promiſed to publiſh them. Having detected, this and being obliged to return, upon another occaſion to the city, I took that opportunity of making a courſe of experiments upon the waters before the magiſtrates and the reſt of the phyſicians, expoſing this ignorant plagiary, as he deſerved. At Spa, I made and repeted mine experiments, as publicly. Which had this good effect, if they produce none other, that a gentleman, who had ſent a manuſcript treatiſe on theſe waters to the preſs, called it back, and did not publiſh it for a conſiderable time

[a] ERNON.

after

after I had left Leyden, where he printed it. Without charging this gentleman with plagiariſm, I ſhall onely ſay, that we now agree in many points, in which, by the accounts of his and mine apothecary, and the gentleman, to whom he had ſent his manuſcript for publication, we differed much before. At Bath, I proceeded with the ſame openeſs, regardleſs of theſe little artifices, and thinking it indifferent, who ſhould appear the publiſher or diſcoverer of the truths, of which I was in queſt. Obſcure, as I was there, an oppoſition to a public, and long, and univerſally eſtabliſhed notion of the Bath waters being ſulphureous, could not fail of making ſome noiſe. The phyſical faculty treated it with great contempt, as I have ſince learned; judging, as they preſumed the world would judge, the man no better, than a fool or mad, that ſhould dare to ſet himſelf in oppoſition to all the writers and practicioners of many preceding ages, with the full concurrence of thoſe of our enlightened age. Whatever light impreſſion this might have made upon the phyſicians, the gentlemen of the corporation, who, however the ſons of Aeſculapius may ſtand affected, have generally no ſmall eye to gain; were ſo far alarmed, that one of their members, a conſiderable common-council-man in the city, came to me with a complementary meſſage from his brethren of the council; who were, as he ſayed, greatly alarmed by the relation, he gave them, of the experiments and obſervations, I had made upon their waters; particularly, in ſhewing, that they were not, as was then univerſally believed, impregnated with ſulphur. He ſayed, "They were very ſenſible of the great pains, I had taken, and were ready to ſhew me all marks of due reſpect; but, that they were not without ſome uneaſy apprehenſions at the fate of their waters, on which the ſubſiſtence of the town and corporation depended, in caſe it ſhould be once believed, or even controverted, that there was not ſulphur in the Bath waters." I thanked this eminent citizen and his

his worſhipful brethren of the council, for their compliments; but, did not think myſelf intituled to even this, much leſs any further, mark of their reſpect. I told him, I came to their city in ſearch of phyſical knowlege; which, if I could obtain, I ſhould hold myſelf bound in duty to impart to the public. That, as to their fears about the future ſucceſs of their waters, from any controverſy about their contents, or from demonſtrating, that they were not ſulphureous; I looked upon them to be quite groundleſs; ſince the great cures wrought by Bath waters muſt keep up their reputation; and as it muſt appear, that thoſe were not wrought by brimſtone; the ſhewing, the waters contained no brimſtone, could onely ſhew, that their virtues depended on other, and quite diſtinct, principles and qualities; which could onely help to aſcertain what they might and what they might not perform, and to eſtabliſh a juſt and rational, inſtead of a mean and empirical, practice, which had too long ſhamefully prevaled, with reſpect to theſe excellent waters.

§ 147. Here, I quit ſight of mine eminent counſilor; from whom, as well as common fame, I had heared, that a very curious, ſenſible and learned phyſician of the town, who had had better opportunities, than ordinary, of learning thoſe very requiſite, though too much neglected, qualifications for a thorough bred phyſician, pharmacy and chemiſtry; was ſometime engaged in a diſſertation on the ſubject of theſe waters; the publication of which was now daily expected. I longed for it, as much as any man. It appeared the year following. I wiſh, I could ſay mine expectations were anſwered! I muſt own, they were not. And, as I had rather avoid, than mention an author, I can not cite to his honor, I ſhould have overlooked this treatiſe, and kept clear of controverſy, as far as conſiſtent with a juſt regard to truth, were it not evident to me, that the author attempts, in two inſtances, to ſtrike at me: The firſt, in anticipating

pating the diſcovery of the Bath ſulphur, as it is called, being but a vegetable; the other in ſaying, without mentioning me, "It is a controverted point, "whether or no the Bath waters be impregnated with "ſulphur." To evade which, he afterwards has recourſe to the loweſt ſubterfuges.

§ 148. As to the firſt, I ſhall not diſpute the diſcovery with any man. It may be his, mine, or any man's. He muſt be utterly unacquainted with ſome of the great requiſites for a phyſician, a knowledge of nature, and of the chemic art, who could view this production, and examine it by the teſts of his own ſenſes, void of prejudice or craft, and not clearly diſcern it to be a vegetable production. This gentleman was well acquainted with Bath, before I ſaw it; and of courſe, might, and ought, to have obſerved this miſtake, before me. I ſhall onely ſay, I am glad it is at length detected, and think it an horrid ſhame, it was not diſcovered ſooner. But, as to the ſecond, the "controverted point," it cannot be arrogance in me to ſuppoſe this learned gentleman meaned me alone; as I am the onely man, who now publicly denies the exiſtence of ſulphur in Bath waters. That being the caſe, he merits particular animadverſion; which muſt therefore be made, as far as the work deſerves any ſerious attention: For, I do not hold it neceſſary to expoſe this author's making experiments upon an infuſion of brimſtone in common ſpring water, which he never ſaw without ſalt, oil, and earth; and attributing the precipitations, and ſome other changes wrought in it, to the ſulphur, when moſt of the appearances produced, muſt accrue from the like experiments, with the water alone; his ſaying, that Bath water and common ſalt, as well as all mineral acids, alike cauſes black precipitations with the ſolution of ſilver; his extracting a ſulphureous tincture from the reſiduum of Bath water, and ſalt of tartar, which this ſalt alone would as effectually give; and many ſuch like pretty little diſcoveries and obſervations, all which

are

are either contradicted by himſelf in the ſequel, as in the experiments with the ſolution of ſilver; or are obviouſly abſurd to the meaneſt chemical capacity. Some of theſe, I ſhall glance at occaſionally, curſorily, under the proper heads; here, contenting myſelf with onely pointing out his inconſiſtent evaſions, when he cannot ſupport the general notion of the waters of Bath being charged with ſulphur; attempting, by awkward or diſtorted definitions, to bring in the oily matter, of which hardly any water is found free, as has been ſhewn in the analyſis of the waters of London[a]; under the denomination of ſulphur. He ſays, the word ſulphur ſhould not be confined to the mineral called brimſtone, of which he is pleaſed to point out but a few of the characteriſtics; whether through ignorance or deſign, I ſhall not determine; but, would have it extended, ſo as to comprehend all unctuous bodies. In which ſenſe, he ſeems to think Bath waters intituled to the appellation of ſulphureous, or that this oily body may be looked upon as their ſulphureous principle.

§ 149. If we once deprive our words of their commonly received meanings, we may appear equally right of either ſide any argument. The Doctor probably thinks, he has confered a great obligation on his fraternity, at Bath eſpecially, by taking from their words all ſenſe and meaning. Now, Brimſtone is to be called onely fat, and all fat or oil is to looked upon as brimſtone! There can be no falſehood nor abſurdity, according to this new way of reaſoning, in calling Bath waters ſulphureous; ſince this oily ſubſtance, of which no water is free, is in the Doctor's eſtimation ſulphur. This ſurely is an happy expedient, a fine aſylum for ignorance and craft! Let me at once teach the Doctor and his aſſociates one equally juſt, and more effectual for their pupoſe; let them but boldly thus change the names of places and men; let them ſay, that the name of Aken or Aix la Chapelle, or Aix in Provence, or Aix in Savoye, ſhould no longer

[a] Part I. § 100.

be

be confined to theſe places; but, that they ſhould be underſtood in a more extenſive ſenſe, ſo as to comprehend all warm baths in general; under which, they might take in Buckſton, Briſtol, Mallow, Bath, &c. And then they may, with like propriety and juſtice, take to themſelves the names of ſome illuſtrious perſons, no matter whether living or dead. This cannot ſeem extraordinary or difficult to a man, that would ſo groſly contend for confounding ſulphur and unctuous bodies together: Since the hiſtories and characters of the greateſt philoſophers, antient or modern, will as well fit any of the writers upon Bath waters, dead or living, or the hiſtories and characteriſtics of any of theſe foregne baths, as well ſuit ours, as thoſe of ſulphur may be found ſuitable to thoſe of unctuous bodies in general. For my part, I think, there is great room to dread ſuch a confuſion, being by this means, ſometime or other, univerſally introduced. We ſee, it has already made ſome, and is ſtill making a rapid, progreſs. Why may not every warm, natural bath be called Aix, as well as every water, impregnated with iron is, not onely by the vulgar, but by thoſe, that ſhould be more correct, called Spa? Let us here, take leave of this learned and accurate naturaliſt and chemiſt, to purſue more intereſting enquiries; onely deſiring, he will upon the whole, obſerve the lenity, with which his volume is treated; for, if he ſhould think otherwiſe, it is eaſy to come to further, but leſs pleaſing, explanations.

§ 150. Having found an acid of a ſubtil, volatile nature in our water, and that, without any appearance of ſulphur, by the common experiment; let us regularly purſue our examen, and ſee what elſe it may be found to contain.

§ 151. This acid undoubtedly procedes from the pyrite; of which, a portion is brought in powder, the Bath ſand, as it is called, into the ciſtern of the bath;

[a] § 95. 1. § 104. 1,

the phlogiſton having by ſome means eſcaped. What then are we to expect?—An union of the metallic parts of the pyrite with the acid of the ſulphur, that compoſed it; the inflammable principle having flown away, either in the decompoſition, without mixing with the water; or perhaps, being loſſed in it's paſſage, before the waters are diſcharged at the bath. Let us then ſee, what evidence we have of Bath water's containing iron.

§ 152. 2. The infuſion of Campechy log-wood, ſix drops to two ounces [a] of the water, at the pump, gives a pale violet blue; but, ſo weak a dye from the martial impregnation, that when the quantity of the infuſion is increaſed, it's tincture becomes predominant over the blew. In about eight hours, the coloring matter is moſtly precipitated; leaving the liquor of the color of French white wine.

§ 153. 3. In the cold corked water, this produces a roſe purple; which color, in about the ſame time, appears precipitated; leaving the ſupernatant liquor of a muddy red.

§ 154. 4. In the cold open, it ſtrikes ſome ſhades lighter in the ſame color, which in the ſame time precipitating, leaves the liquor alſo paler.

§ 155. 5. The ſame with the water, as ſent to London, ſtrikes a deep ſcarlet dye, and holds it, without variation, for ſeveral hours.

§ 156. 6. The waters of the Hot and Croſs baths, in the ſame manner treated, give ſimilar appearances, the colors ſeemingly paler.

§ 157. 7. The infuſion of galls, five drops, ſoon after mixture, ſtrikes a pale, roſe purple, which rather obſcures, than highthens by increaſing the quantity of the infuſion. Not long after, it becomes milky and turbid. In about eight hours, the coloring matter appears precipitated; leaving the ſupernatant li-

[a] Two ounces.— N. This quantity is to be underſtood in every experiment, where none other is ſpecified.

quor

quor of a kind of whea color, with it's ſurface covered with a diverſicolored pellicule. The liquor grows finer, turns to a blewiſh, and afterwards to a perfect green, upon ſtanding.

§ 158. 8. The ſame, in the cold corked water, ſtrikes ſome ſhades paler of the ſame color; is leſs milky; lets fall the like precipitate, in much the ſame time; leaving the liquor of the ſame color, and with the like pellicule, as in the hot.

§ 159. 9. The ſame in the cold open water, ſtrikes ſeveral ſhades paler, than the preceding; give a proportionable precipitate, in the ſame time; leaving the liquor of the ſame color, and with the like pellicule, as in 8.

§ 160. 10. In the water, as ſent to London, it ſuffers no change of color; but grows ſomewhat milky and turbid; turns green, and throws up the ſame pellicule as the reſt.

§ 161. 11. The two other waters, with the ſame mixture, exhibit ſimilar appearances; the colors rather paler, and requiring a drop or two leſs of the infuſion.

§ 162. 12. The infuſion of chochinelle, three or four drops, gives a violet purple; if increaſed, the color of Florence wine. Upon ſtanding, about eight hours, the coloring matter ſeparates, and in part precipitates, with more of the roſe than the violet in the purple.

§ 163. 13. The ſame in the cold corked water, has the like effects; the color and precipitate paler.

§ 164. 14. The ſame in the cold open, has the like effects, paler ſtill.

§ 165. 15. The ſame in the water, as ſent to London, a bright pink color.

§ 166. Theſe ſeveral experiments, from 2 to 15, incluſive, ſhew the martial ingredient, and how it is loſſed, and in what proportion, by the manner, or length of time, in which it is taken from the ſource.

§ 167. In ſuch chalybeate waters as thoſe of Pyrmont or Spa, the metallic parts and their proportions

are eaſily demonſtrated, in the ſubſidence upon ſtanding[a]. But, there is nothing more difficult, than to determine the proportion of iron in any given quantity of this water. There are two ways of judging it; but theſe are relative, not poſitive. The one is from the color of the ſediment: The ſtronger and purer the impregnation of iron, the higher the color of the ſediment, the nearer it will approach to that of ſaffron of iron or Spaniſh brown. But, the ſediment of Bath waters is but a very pale ochre color. Conſequently the impregnation is not ſtrong, nor pure; for it contains much of another kind of earth, than that purely martial, as ſhall be further demonſtrated in the ſequel. The other is, from the highth of the color, which ferrugineous waters ſtrike with aſtringent vegetables. The illuſtrious medical ſociety of Edinburgh, who have greatly increaſed our funds of phyſical knowledge in general, have by the aſſiſtance of that ſhining ornament of his profeſſion and this ſociety, Mr. MONRO, thrown ſome new lights upon this ſubject in particular, to which we muſt be indebted for the further illuſtration of this matter.

§ 168. The whole art of dying conſiſts in knowing what bodies, mixed in certain liquors, produce certain colors; and what bodies are capable of precipitating the coloring matter in ſuch a manner, as it may beſt be imbibed and retained be the pores or tubes of the matter to be dyed. All acids diſſolve iron; all alcalies and abſorbents precipitate it. All martial or chalybeate waters conſiſt of iron diſſolved in ſome kind of acid. Galls and all aſtringent vegetables, act as abſorbents, and cauſe a precipitation, in color, from different ſhades of purple or blew, to black, according to the nature of the acid in which the iron is diſſolved, and the proportion of the ſaturation or ſtrength of the ſolution. The ſtronger the ſaturation or ſolution of the metal, the more of the aſtringent it will require,

[a] See Spa, § 100. 4.

and the deeper the color it will ſtrike; and ſo on the contrary; the weaker the ſaturation, the leſs of the aſtringent, and the paler the color of courſe.

§ 169. Now, to aſcertain, as well as we may, by compariſon, the proportion of iron, in a given quantity of any water, let ſeveral equal portions of water be charged with different proportions of ſalt or vitriol, of iron or any ſolution of that metal, whoſe proportion to that of the ſolvent is determined. Let theſe be marked or numbered 1. 2. 3. &c. Let the quantity of infuſion of galls or any other aſtringent vegetable, be dropped into the natural ferrugineous water to be tried, that is found to produce the deepeſt dye. Let it be dropped, in like manner, into the ſeveral equal portions of artificial ferrugineous water; and that, in which the like proportion of the vegetable infuſion produces the likeſt pitch of color, may be judged to point out the quantity of iron in the like portion of the natural mineral water.

§ 170. The above cited Mr. MONRO obſerves [a], that the proportion of iron in it's ſalt or vitriol, is but little more than one third; the other two thirds being the vitriolic acid and water. According to this ingenious gentleman's computation, if one ounce of this ſalt of ſteel, as it is called, be diſſolved in twenty ounces of water, every drop of this ſolution, of which he ſays 142 weigh two drachms, will contain one ſeventy fiveth part of a grane of the metal.

§ 171. Having then, found the quantity of the infuſion of galls, that cauſed the deepeſt dye in the king's bath water; and having charged a certain number of glaſſes of like makes and dimenſions, filled with pump water, heated to the ſame pitch of the bath, with different quantities of the above ſolution of iron; I found the color, neareſt to that in the Bath water, was produced with the like quantity of the infuſion of galls, in the glaſs, that contained the ſolu-

[a] Medic. Eſſays, vol. III.

tion of iron, in the proportion of two drops to a pint. So that as far as this experiment may be relied on, which may be ſubject to ſome incertainty, each pint of king's bath water may be ſuppoſed to contain about one thirty ſeventh and half part of a grane of iron. Which, while it demonſtrates the extreme diviſibility of this metal, ſhews how little men know of theſe waters, and what they have to truſt to, who rely upon them, as ſtrongly impregnated with iron, or ſteel, as they idly affect to call it, of which, each of the others contain ſtill ſomewhat leſs; according to this method of calculation.

§ 172. Nothing can be more ridiculous, than the whimſical notions, certain men have conceived of a volatile vitriol in ſome ferrugineous waters; except the attempts made to catch and condenſe this volatile vitriol, by ſome of the pretenders to chemical knowledge, that have appeared among us, ſince the ſhameful neglect, I may ſay, the declenſion, of that moſt uſeful art among us. We have had here, as well as abroad, great profeſſors of chemiſtry, in this laſt century, who talk in different parts of their voluminous works, as familiarly of fixed and volatile vitriols, as of fixed and volatile ſalts; and tell us, that in the moſt celebrated mineral ſprings, whether hot or cold, there is no fixed vitriol to be found; but, that the beſt of theſe are impregnated with a fine, volatile vitriolic principle. As men's greatneſs, in ſome wretched countries, is commonly eſtimated by the number of their ſlaves; ſo may phyſical great men be often denominated from the number of their followers, or of the underſtandings, they have captivated. Of theſe ſlaviſh followers, we have not a few, who never preſume to think for themſelves; but ſervilely imitate their leader. It will not be wondered at, that your dealers in volatile vitriol ſhould lay variety of traps and ſpringes to catch this imaginary fugitive; as men do to enſnare foul. Thus, the vapors of natural baths and other waters collected in bladders and ſet looſe in

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infuſions of galls, or ſet to evaporate or deſtil upon rags or papers ſoaked in tinctures of galls, are trite experiments, which ſome men make without being aſhamed of proclaming their follies or ignorance in recording their bad ſucceſs.

§ 173. What gives riſe to the idle notion of a volatile vitriol is the obſerving, that Pyrmont, Spa, and other chalybeates abroad, and Bath, Scarborough, Cheltenham, and other waters with us, which at taking up, ſtrike ſome ſhades of purple and black with galls; upon being removed from their ſources, and kept ſome time open to the air, and ſome of them, though ever ſo cloſe corked, loſe their gall-tinging quality. This is ignorantly attributed to an immature iron, a volatile ſteel or a volatile vitriol; becauſe ſuch waters are found to yield no common, or as theſe mock-chemiſts chooſe to call it, fixed vitriol, upon evaporation.

§ 174. A degree beyond the moſt ſuperficial knowledge in chemiſtry would ſave theſe men, and their followers, a world of trouble, and ſhew them how to account, by eſtabliſhed rules of art, for this, to them ſeeming, volatility of vitriol.

§ 175. Iron is known, to the moſt ignorant in chemiſtry, to be ſoluble in every acid. When it is diſſolved in the moſt fixed, the acid of vitriol, it gives by evaporation and cryſtaliſation, common coperoſe, green vitriol, or as it is inelegantly and improperly called, ſalt of ſteel. This vitriol may be diſſolved in water, and again evaporated and cryſtaliſed; but every time this is repeted, ſome degree of decompoſition of this union will be produced; the acid will be diſſipated or otherwiſe deſtroyed, and a martial earth will ſeparate and precipitate; until, at laſt, a total decompoſition may be wrought. The more volatile the acid, the ſooner and eaſier is this change effected.

§ 176. But, in order to give a clearer notion of the matter, let what has been ſayed in our idea of ſalts, of affinities, &c. be here recollected: It will

then be found, that not onely alcaline ſalts, but abſorbent earths, precipitate iron from it's ſolvent, in proportion, as it is by theſe ſaturated. A water then, impregnated with iron, may take in ſome portion of an abſorbent earth, or alcali, without precipitating all the iron; as a water partly charged with an alcali or abſorbent earth, may ſtill diſſolve ſome iron, if the acid be predominant or not quite ſaturated. In either caſe, diminiſh the ſtrength of the ſolvent, by letting the acid fly off in open air, or otherwiſe, or by abating the heat in natural hot chalybeates, or by giving heat to cold chalybeates, or by any means increaſing the proportion of the alcali or abſorbent to the water; the firſt part of the ſolid contents of ſuch a water, that ſeparates, muſt be the metallic, the martial earth; and as ſoon as it ſeparates, by this or any other means, the aſtringents or vegetable abſorbent can cauſe no precipitation, no color, or other effects; becauſe, they do not find the iron in a ſtate of ſolution.

§ 177. Thus, may this phaenomenon be ſimply explaned, without looking for non-entities, volatile ſteel or vitriol, or attempting to ſhew by experiment, that ſuch can not be caught or collected in making their eſcape. The metallic parts do not fly off, in ſuch caſes; they always precipitate, as the ſolvent eſcapes in the air, or is otherwiſe weakened; and, in that form, may be found remaning in the liquor, when it ceaſes to tinge with galls. It is likewiſe owing to the redundance of alcalies or abſorbents, that moſt chalybeate waters leave no common vitriol upon evaporation: For, the firſt thing, that precipitates in weakening the ſolvent in that operation, is that, that has leſt attraction with the acid, and that is always found to be the iron. By this means, the iron is ſeparated from the terrene or ſaline parts of any water; as has been ſhewn more at large in treating of Mineral Waters in general, Part II. Introduction, § 61. 10. and of thoſe of Spa in particular.

§ 178.

§ 178. As a further proof, that this is a decompoſition, ariſing onely from the weakening the ſolvent by evaporation, exhalation, or the like, and by no means owing to the volatility of the diſſolved metal; let but a proper quantity of the vitriolic acid be added to any chalybeate water, that has ſuffered this change, and it's gall-tinging quality, is preſently reſtored; or if added, before the change is wrought, the acids will prevent ſuch a change. This alſo proves, the air is none other ways concerned in theſe decompoſitions, as ſome have vanely imagined, than as the eſcaping ſolvent gets a free entrance into ſuch a portion of that fluid, as comes into contact with the mineral water. Hence, the leſs air is bottled up with any ſuch water, the leſs and the ſlower muſt it's mineral ſpirit be able to eſcape; and conſequently, the longer and better will the water retain it's qualities.

§ 179. Having now ſhewn, that Bath water contains a ſubtil acid, which partly flies off in the open air, and a ſmall quantity of iron, which ſeparates, as the acid or heat diminiſhes or is loſſed; let us ſee what makes up the reſt of the compoſition; but firſt, let us examine what further proofs of an inherent acid, this water gives.

§ 180. 16. Poured upon new, clean, filings of iron, the action of ſolution is ſoon manifeſted, by the filings being covered over with ſmall air bubbles; which, as they enlarge, buoy up ſome particles of the iron and carry it to the ſurface; whence, the air bubble breaking, it falls back again to the bottom. This operation continues, till the water looks like a muddy ſolution of iron, which ſoon happens. It now acquires a much ſtronger vitriolic taſte, than it had before; ſtrikes a beautiful, rich bloom purple with the infuſion of galls, of which it admits more than double the quantity, the water by itſelf requires, to ſtrike it's deepeſt dye. As it cools, the iron begins to ſeparate, and falls like ruſt to the bottom; while it throws up a pellicule of all colors. The precipitation and pellicule appear diſtinctly formed in twenty four hours. It then retains

retains it's gall-tinging quality; but, not ſo ſtrong as whileſt hot. And the coloring matter does not precipitate in this ſaturation as readily, as in the thermal water alone with the ſame infuſion.

§ 181. This ſhews an acid in the water, which is capable of diſſolving more iron; which is planely incompatible with a ſolution of ſulphur, as ſome would have theſe waters thought. But of this, we ſhall offer further proof.

§ 182. 17. Two parts of this water, hot from the pump, poured into one part boiling milk, and continued on the fire, till the whole gets another boiling heat, the milk is as completely coagulated, as with moſt acids. Equal parts curdle, but imperfectly.

§ 183. This is an experiment familiar to nurſes at Bath. And Bath-poſſet, or Bath-whea, is uſed in common practice. From the nature of the curds and whey, and from other collateral proofs of an acid, this coagulation can be attributed to none other cauſe. How then could this be, as it has been, and ſtill is, deemed, a ſolution of ſulphur, which can not exiſt with acids; ſince all known ſolutions of ſulphur muſt be precipitated by acids of every kind?

§ 184. 18. This coagulation ſuccedes with both the other waters, much alike; ſeemingly inferior to that of the king's bath.

§ 185. 19. Each water, not onely cold corked, but cold open, produces the ſame effect. As they alſo do after many minutes boiling; even when a ſeparation of their earth is partly formed.

§ 186. 20. The water, as ſent to London, produces the like effects upon milk in all reſpects.

§ 187. So that after it has loſſed the acid, that diſſolved the iron, an acid fixed enough to reſiſt the heat of boiling water a conſiderable time, ſtill remanes in it, and produces this effect, common to all acids. And, that it contains ſuch an acid, utterly incompatible with a ſolution of ſulphur, will appear by ſeveral ſucceding experiments. It is true, this acid is, in a great

great meaſure, ſaturated with terrene matters, as well as diluted with water, as to be imperceptible to the ſenſes; but ſtill, theſe effects are to be attributed to the mineral acids onely; any of which, though ſaturated perfectly with abſorbent earths, or even mineral alcalies, produce theſe effects with milk.

§ 188. 21. A ſolution of ſulphur in an alcaline ley, muſt mix with all ſimilar ſolutions, without commotion or change; whereas, mixed with acids, of every kind known, the ſulphur is precipitated in proportion as the alcaline ſolvent is ſaturated. This is a fact known to the apprentices of apothecaries. Such a ſolution, dropped into Bath water, ſuffers a ſimilar change; it grows inſtantly milky, gives a putrid ſmell, a double decompoſition is performed; the ſulphur in the ſolution is precipitated by the acid of the water, whileſt the earthy parts of the water are precipitated by the alcali in the ſolution.

§ 189. How then are we to preſume Bath water, a ſolution of ſulphur, or a ſulphureous water, in any ſenſe of the word, when it gives none indication of that mineral, upon any trial, and is not even capable of holding it ſuſpended, when it is added in a ſtate of ſolution?

§ 190. As volatile and fixed alcaline ſalts have the ſtrongeſt affinity with acids; they are uſed to prove waters, which they do by uniting with, and ſaturating the acid, that before kept metals or earths in ſolution; by which the metallic or earthy matters are precipitated, and a neuter ſalt produced, which determines the nature of the acid.

§ 191. 22. 1. A liquid volatile alcali, for inſtance, Spirit of Hart's-horn or Salt ammoniac, thirteen drops, occaſions a ſlight ebullition, cauſes a milkineſs with a yellowiſh hue, which gives a light precipitate of the ſame caſt, and throws up a terrene pellicule. 2. The like effects are produced more ſlowly, leſs ſenſibly, and more white, in the water cold corked and cold open. 3. In the water, as it is ſent to London,

the

the like precipitation, without any ſenſible change of color, is occaſioned.

§ 192. Here, the volatile alcali, precipitating the iron, while it is yet diſſolved in the water, more or leſs in 1. 2. cauſes the change of color, which is obſcured by increaſing the alcali, ſo as to cauſe a complete precipitation of the other earth's diſſolved in the water. The reaſon why this change of color does not happen in the water, as it arrives in London, appears from conſidering, that in this, a more groſs precipitation of the iron has already been wrought, by the loſs of the mineral acid with the heat, that ſuſpended it.

§ 193. 23. A concrete or dry volatile alcali, ſix granes and even leſs by half, cauſes firſt a ſmart ebullition, which is immediately attended with a pale milkineſs. In about eight hours, a ſubtil white precipitate ſubſides to the bottom and ſlides off the glaſs, and a light terrene pellicule covers the ſurface of the liquor.

§ 194. 24. The like effects are produced in the water cold corked, cold open, and as it arrives in London.

§ 195. How theſe changes, particularly the ebullition, are accounted for, may be ſeen in explaning theſe like experiments upon the preceding waters[1]. Theſe experiments, § 188. 21. ſhew a precipitation of the ſolid matters, by means of an acid, ſuſpended and diſſolved in the water. The precipitation completed, the acid being ſaturated with the volatile alcali, gives Glauber's ſecret ſalt ammoniac, which proves the acid to be vitriolic. This ſhews the changes wrought in the waters by the common practice of giving volatile ſpirits and ſalts with them. All theſe experiments, from 179 to 202, inſtead of an alcali, as modern analyſers aſſert, ſhew the reverſe, an acid in the waters of Bath. Hence, the abſurdity of giving alcaline or ſopy medicines with the waters muſt appear, as it alſo does, how much, how groſsly they miſtake, who preſcribe milk to be taken with theſe,

[1] Aken § 246 to § 256.

which

which manifeſtly curdle them; as the beſt módern practicioners direct with ſome of the German waters, that are found to prevent a coagulation.

§ 196. 25. A ſtrong alcaline ley, ten drops, occaſions a ſlight ebullition, cauſes a milkineſs even to opacity, with a copious, white precipitate, and a terrene pellicule, in each of the waters; in the ſame, cold corked, cold open, and as it arrives in London, the like effects are produced; but, the ebullition more ſlow and imperceptible.

§ 197. 26. A dry fixed alcali, from ſix to three, granes, cauſes a quick and ſtrong ebullition, which is immediately followed by a milky opacity, and ſoon after, by a copious, white precipitation and a terrene pellicule.

§ 198. 27. The ſame cauſes the like changes in the water cold corked, cold open, and as it is ſent to London, the ebullition not ſo quick or ſtrong.

§ 199. The reaſons for theſe changes have been given in the like experiments upon other waters [a]. It is ſuperfluous to repete them here. It is onely neceſſary to obſerve,

§ 200. 28. That any of theſe bath waters being charged with volatile or fixed alcalies, whileſt the addition of them cauſes any milkineſs, then filtrated to ſeparate the earthy parts and evaporated to a pellicule, ſo as to cryſtaliſe, or to a dryneſs, yield, in the one inſtance, Glauber's ſecret ſalt ammoniac, in the other vitriolated tartar; both which demonſtrate the nature of the acid and the abſurdity of ſuch practicioners, as give ſuch ſalts with theſe waters, which is frequently done.

§ 201. 29. Sope will not diſſolve in Bath water; and being added in a ſtate of ſolution, it is immediately curdled and decompoſed; ſo that the acid in the water and the alcali in the ſope unite and conſtitute vitriolate tartar; while the oil or fat part of the ſope

[a] Aken § 251. 28. § 252.

ſeparates.

ſeparates. Hence, the nature of the water, and the abſurdity of giving ſope, and ſopy medicines with them, muſt evidently appear. How then can theſe waters be deemed ſaponaceous, by Doctor Oliver and others?

§ 202. 30. To this doctrine of acids in theſe waters, the trite experiment with ſirup of violets, generally uſed to prove the exiſtence of an alcali in the water; may ſeem to be repugnant. It muſt be confeſſed, that a tea ſpoonful of this ſirup, of a good color, gives a ſea green, upon mixture with the water, and that this color improves by degrees, till, in about eight hours, or ſooner, it appears of a beautiful, bright graſs green.

§ 203. 31. It works the ſame changes, but more ſlowly in the water cold corked.

§ 204. 32. The ſame, ſtill ſlower, in the cold open. And,

§ 205. 33. It cauſes no change upon mixture, or for ſome time after, in the water, as it is brought to London; but, in ſome hours, ſhews a pale ſea green, which does not improve in many more.

§ 206. In theſe, the acid is not developed enough, not enough diſengaged from the terrene bodies, it holds diſſolved in the water, to attack the ſirup and change it to a red. But, the green color induced is, by no means, to be attributed to that, to which it is commonly imputed, an alcali; ſince, that appears upon none other trial to be contained in the water; and ſince every ſolution of iron in an acid, and even that of a certain abſorbent earth in the vitriolic acid, alum, in which an acid is always planely predominant; cauſe the like changes in ſirup of violets. In confirmation of this,

§ 207. 34. All the ſimple, as well, as fermented vegetable acids mix without working any commotion, or other ſenſible change in the water, in any ſtate, hot or cold.

§ 208. 35. Deſtilled vinegar, cauſes no change of color or other alteration in it.

§ 209. 36. The mineral acids, except in a concentrated ſtate, or when the vitriolic is added in ſuch quantity, as to excite more heat; mix without any commotion, or other ſenſible change, but that of preſerving or reſtoring their pellucidity, with the waters, hot or cold.

§ 210. Which certainly could not be the caſe, had there been any thing alcaline contained in the water; the contrary of which, other experiments coincide in proving. Let us now ſee what appearances are exhibited by metallic ſolutions.

§ 211. 37. The ſolution of corroſive ſublimate, to twenty four drops, cauſes no perceptible change, for a conſiderable time. Viewed after ſtanding eight hours, ſome ſlight milkineſs is diſcovered, without any viſible precipitation; and the ſurface is covered over with a muddy pellicule of all colors.

§ 212. 38. The ſame produces the like effects in the two other waters, as well as in this, hot, cold corked, cold open, and as it arrives in London.

§ 213. Had there been, 1. Sulphur in any form united with the water, or 2. Much of the oily ſubſtance, common to moſt waters, which ſome of our new analyſers look upon, as the ſulphureous principle, or one of the principles of ſulphur; though every accurate chemiſt conſiders this, as a compound, not a ſimple body, or a principle; had the water been charged with either of theſe, a conſiderable milkineſs with both, and a precipitation would have enſued. In like manner, had it contained an alcali, either, 3. fixed, or, 4. volatile, a milkineſs and precipitation muſt have been cauſed, darker with the 3. whiter with the 4. But, there is none appearance of the 1. 3. or 4. by this or any other experiment to me known; and therefore, I muſt impute to the 2. of whoſe exiſtence we ſhall ſee ſome proof in the ſequel, the changes wrought in this experiment.

§ 214. 39. The ſolution of quickſilver, eight drops; at each, a bright, milky cloud, growing ſuddenly opac, precipitating and changing to a pale yellow, is occaſioned. If the mixture be permitted to ſtand without ſtirring, there is an heavier precipitate, of the color of turpeth mineral formed at the bottom, with a white and lighter one over it; if it be agitated quickly after, or upon mixture, it becomes and continues all over equally white. If ſtirred, after ſtanding half a minute, it will keep it's yellowneſs.

§ 215. 40. The ſame in the water cold corked, and cold open, as well as in the condition, in which it is uſually brought to London, produces ſimilar effects.

§ 216. 41. The waters of the Hot and Croſs baths, treated in the like manner, exhibit the like appearances.

§ 217. A late analyſer of the Bath waters, tells us, that this ſolution gives an orange colored precipitate in them. It appeared to me in a different light. I am the more apt to think, he committed an overſight in this, becauſe, he attributes the color and precipitation to a wrong cauſe. He ſays, it is owing to the ſame cauſe of the greenneſs with the ſirup of violets, which he aſſerts to be an alcali. Now, neither a fixed nor a volatile, mineral alcali, in the proportion, in which theſe waters appear impregnated, can cauſe an orange colored, nor a yellow precipitate in a ſolution of quickſilver in the acid of nitre. But, as they do not exiſt, a precipitate of the color mentioned muſt be formed by the real, not imaginary, contents of the water. Theſe are, 1. iron, 2. an abſorbent earth, 3. ſome ſea ſalt, and a priſmatic, bitter ſalt; 4. a portion of the oily matter; all, with the 5. the univerſal acid, diſſolved and united with the water. The 1. and 4 are in too ſmall quantities, to have any ſenſible effect in this decompoſition; an union of the 2. and 5. cauſe this yellow colored precipitation, as that acid ſaturated with fixed alcalies alſo does;

does; and the 3. occaſions the white precipitation, as agitation alſo makes the whole equally white. This, I take to be the true etiology of this experiment; as the judicious will eaſily conceive, and the curious may, at their leiſure, prove; if not convinced by other ſucceding experiments.

§ 218. 42. The ſolution of ſilver, every drop, to about ten, cauſes bright, bleiſh white clouds, which ſoon coagulate, appear opac, and precipitate ſuddenly in grumes. If agitated, the decompoſition and coagulation, is the more effectually performed. The ſediment, as well as the particules yet ſuſpended, appear, for a long time, white; but, in ſome eight hours viewed, it ſhews ſomewhat of a purple hue; eſpecially, if viewed perpendicularly, or from above downwards.

§ 219. 43. This ſolution cauſes the like changes, 1. in the water cold corked; 2. cold open; and 3. in that ſent to London; each ſeeming ſomewhat paler, than the preceding, in the purple of the precipitate.

§ 220. 44. The ſame ſolution produces like effects in both the other waters, in all theſe manners.

§ 221. This, ſome of our new analyſers make black in one place, white in another, in the ſame diſſertation, juſt as it is thought to ſuit their different purpoſes; and that without aſſigning a juſt cauſe for either. In our idea of ſalts, the various bodies, that have a ſtronger affinity to ſilver, or to the nitrous acid, than the ſilver or the nitrous acid have to one another, have been ſhewn. Any of theſe interpoſed in ſuch a ſolution, muſt decompoſe it. Here then, is a double cauſe; the univerſal acid, and ſea ſalt; each of theſe cauſes a precipitation of the ſilver; theſe acids having a ſtronger attraction with the once diſſolved metal, than it's firſt ſolvent, and forming with it a kind of luna cornua; which is colorleſs or colored, according as theſe acids are pure, or carry with them martial or other earth, or the inflammable principle. But, as there is none of this laſt, in the form of a principle; ſo no color is ſhewn upon the firſt mixture of this ſo-

lution with the Bath water. Of this the next ſucceeding experiment gives ſome further, in mine apprehenſion, inconteſtible proof.

§ 222. 45. The ſolution of lead, every drop, as far as ten or twelve, cauſes the moſt perfectly bright, white clouds, which ſoon grow opac and ſubſide. In leſs than eight hours, the ſides and bottom of the glaſs are covered over with a lovely, white magiſtery.

§ 223. 46. The ſame ſolution cauſes the like clouds and precipitation in the water, cold corked, cold open, and as it is ſent to London.

§ 224. 47. It produces the like effects in each of the other waters.

§ 225. The ſame cauſes, that produce the effects mentioned with the ſolution of ſilver, concur in theſe, wrought by ſea ſalt or it's acid, and the univerſal acid. Had there been ſulphur in any form diſſolved here, or any portion of the truly ſulphureous, the inflammable principle, or phlogiſton, mixed with the water, the aprentice of every apothecary, that knows and attends his proper buſineſs, muſt be able to tell, that not white, but the reverſe, muddy, yellow, or dark brown, or black clouds muſt be the conſequence of the mixture; as we find it in ſolutions of orpiment in water, with quicklime, to make the ſympathetic ink, as it is called; in ſolutions of ſulphur in volatile alcalies, as by means of quicklime and ſalt ammoniac by deſtillation, in making HOFFMAN'S volatile tincture of ſulphur; or, by decoction in water, with quicklime, or a fixed alcali; or a ſolution of liver of ſulphur in water: Any of theſe turn a ſolution of lead, in any vegetable acid, according to the ſubtility and degree of ſaturation, yellow, rediſh, or of a dark brown or black; as has been already obſerved in the waters of Aken[a]; which, whileſt they are able to tarniſh ſilver yellow, by the means of the phlogiſton, with which they are charged, as they always are at the

[a] Aken, § 302. 69. &c.

ſource;

ſource; they never fail of cauſing muddy brown clouds and a ſediment of the ſame color, with the ſolution of lead; but, when by any means deprived of this phlogiſton, they cauſe onely ſuch white clouds and precipitation, as Bath waters are found to do. Whence, we may, I think, with poſitive aſſurance, conclude, that there is no ſulphur, nor phlogiſton, in Bath waters; whatever men, unacquainted with the principles of chemiſtry and nature, ignorant of the proper experiments, or who might have thought themſelves intereſted in concealing the truth, might have heretofore, now do, or hereafter ſhall, ſet forth to the contrary.

§ 226. But, that it may not be ſuſpected, in a matter of this moment, that any material evidence ſhould be omitted; let us purſue our enquiries to the utmoſt, and call every experiment to our aid, that tends to illuſtrate this important matter; though thoſe that have already been offered, be more than ſufficient.

§ 227. 48. A ſolution of green vitriol, in deſtilled water, is ſoon decompoſed by being dropped into this water; it firſt cauſes milky clouds, with a pale yellowiſh hue, which ſubſide in the form of an ochrous precipitate.

§ 228. 49. The like effects are produced as well, but not quite ſo readily, in the water cold corked, cold open, and as it arrives at London; as alſo in the two other waters.

§ 229. 50. A ſolution of blew vitriol is, in like manner, though not ſo effectually, decompoſed: At dropping, to about the number of twenty, a kind of opal color is produced; the mixture ſoon after gives a pale, verdigriſe colored precipitate; the ſupernatant liquor retaning ſomewhat of a ſky blew.

§ 230. 51. The ſame appearances and effects are produced upon dropping this ſolution into the water cold corked, cold open, and as it arrives in London; as well as in the two other waters, treated in the ſame manner.

§ 231. Theſe decompoſitions ariſe from the terreſtreity of the waters, which more ſtrongly attracts the acid, that diſſolved theſe two metals, and lets them therefore ſubſide. Some of our modern chemiſts and analyſers, may poſſibly ſay, theſe vitriols are volatiliſed by theſe waters: For, thus is their volatiliſation performed!

§ 232. From moſt of the preceding experiments, every judicious, attentive reader will pronounce theſe, hard, charged waters. It is plane, they can not be fit for any of the purpoſes of waſhing, cleanſing, or cookery. This will more evidently appear, by conſidering the effects, they produce on foul or greaſy bodies; 1. they rather thicken and harden, than diſſolve, thin, or ſoften the dirt. 2. They harden fleſh and vegetables, and diſcolor both, in the boiling. 3. They are not rendered more uſeful in waſhing or cleanſing, by the addition of ſope; for, inſtead of diſſolving, it is coagulated, and is decompoſed upon being added, even in a ſtate of ſolution, to any of the waters, in any ſtate mentioned. But,

§ 233. 52. Powerful, as the acid, by moſt of theſe experiments appears; it is too mild, or not developed enough, to alter the color of the juice of tournſol[a]. This color is highthened and extracted by alcalies; but changed red by acids. It has before been obſerved, that Aken water recovers ſpots made in this paper by acids. So muſt Bath water, had it, like that, contained an alcali. The contrary of which is obſervable.

§ 234. Thus far, our experiments have been made by mixtures; and the compoſitions and decompoſitions thereby produced, we have remarked and endea-

[a] Here, it is fit to inculcate a caution againſt another confuſion introduced by one of our new analyſers of Bath waters; who, inſtead of Tournſol, which is the Heliotropium tricoccum, of CASPAR BAUHINE, directs the uſe of a quite different plant, the ſunflower, which is the Helenium Indicum maximum of the ſame author; which agrees neither in kind, form, nor quality, with the former.

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vored from them, to account for the ſeveral changes wrought, and the ingredients they indicate, in the waters. We now come to put it to other teſts; ſuch as are done by fire, to ſeparate the volatil and fixed, the fluid from the ſolid contents.

§ 235. 53. I put two quarts of the King's bath water, newly drawn from the pump, into a glaſs body of a convenient ſize; placed it in a ſand furnace; adapted a fit head and recipient; luted the junctures, all as expeditiouſly as poſſible; and then gave the degrees of fire neceſſary for deſtillation. Whereupon, dewy drops appeared in the upper part of the body, and in the head. Theſe trickled down into the recipient. As ſoon as two or three drachms had deſtilled, I took it out, and examined it. This agreed in all ſenſible qualities with common deſtilled water; nor was it found to differ ſenſibly, in any quality, from it. Nor did this firſt deſtillation differ ſenſibly from what the deſtillation protracted gave. The remaning liquor depoſited much earth.

§ 236. 54. The like experiments made upon each of the other waters, gave preciſely the ſame produce.

§ 237. This may at firſt ſight ſeem an argument againſt the poſition of a volatile acid in theſe waters. But, when it is conſidered, that this acid is extremely ſubtil, and but in a very ſmall proportion in the water; and that from this ſmall quantity of the water, little at beſt could be expected, and that that little can not ſo effectually be collected in deſtillation, as to ſuffer no waſte, no loſs by tranſpiring the junctures, even before any of the water can deſtil; and that if any ſhould remane and deſtil with the water, it muſt be as imperceptible, as that portion of the univerſal acid, that is mixed in the air, and in every water; the ſeeming contradiction may be eaſily reconciled. I repeted this experiment, placing ſome ſlips of turnſol-dyed paper in the junctures. This anſwered much as at Aken; it was ſlightly ſpotted red; which puts the exiſtence of this acid quite out of doubt. But, could the vapors of theſe

waters be collected from their ſources, as they are propelled by the thermal heat, by the ſame apparatus, as I uſed at Aken[a] in the vapor baths, I make no doubt, our bath waters would give no leſs proof, than theſe of a volatile acid in the vapor. But, till our baths are improved, as I propoſe, or otherwiſe reduced to ſome regularity, we muſt want this proof, as well as many benefits, that might from ſuch improvements accrue.

§ 238. 55. A gallon of the freſh-drawn water of the King's bath, being committed to an open glaſs, placed in ſand, was, by a ſlow heat, evaporated to a dryneſs. In which, the following were obſervable; 1. Nothing ſenſible to the ſmell eſcaped from the beginning to the end of the operation. 2. As the humidity begins ſenſibly to exhale, a terrene pellicule appears upon the ſurface of the liquor; as this pellicule increaſes in thickneſs and weight, as the water diminiſhes; it breaks by it's own weight, and falls to the bottom; but, is ſoon ſucceded by another; of which, there continues this kind of ſucceſſion, till all the humidity is exhaled. 3. The glaſs is coated with this like terrene ſubſtance, from the circle, which the upper ſurface of the water at firſt filling deſcribes, to near the bottom; where the cruſt is covered with ſeveral ſmall, ſaline ſpiculae, whoſe cryſtals reſemble thoſe of Glauber's ſalt. 4. When the humidity is abſumed to about one ſixteenth, the then remaning liquor appears ſomewhat colored, to about the pitch of Rheniſh or French white wine. This highthens, as the liquor diminiſhes; and being at length totally exhaled, leaves a circle of an oily appearance and darker color, than any other part of the glaſs. 5. This reſiduum, thus exactly dried, and ſcraped off, and carefully gathered, weighed two drachms and fourteen granes. Upon repetition of this experiment, I found this proportion, from ſome imperceptible cauſe, vary at ſometimes, to two or three granes leſs, at others to three or four

[a] Aken, § 209.

granes more; I therefore look upon this as the quantity neareſt the medium. A ſingle pint evaporated in a china cup in ſand, often repeted, gave ſeventeen granes, nearly.

§ 239. 56. A gallon of the Hot bath water treated in the like manner, in the ſame apparatus, yields preciſely the ſame appearances and the like product with the king's bath, § 238. 55. Yet it has often yielded a grane or a grane and half leſs in the pint.

§ 240. 57. A gallon of the Croſs-bath-water put to the ſame trial, exhibits the appearances and products exactly ſimilar, as to the ſenſes; but more by eight granes than the King's bath.

§ 241. Hence, we ſee, 1. That nothing of the fetid phlogiſtic matter ſtrikes the ſenſes in the vapor of this water, upon an heat increaſed above the thermal; 2. That the oily ſubſtance, which ſome would palm upon the world for ſulphur, is no more than is found in moſt common waters. 3. That the ſolid contents of King's-bath water are about ſeventeen granes in a pint, wine meaſure, or upon the ſtricteſt calculation, upon the above medium, ſixteen granes and three quarters in a pint; 4. That the ſolid contents of the hot bath are about ſixteen granes to the pint; and 5. Thoſe of the Croſs-bath about eighteen or ſeventeen granes and three quarters to the pint. Who then, can ſufficiently admire the extreme exactneſs, the ſtrict accuracy of thoſe moſt cautious practicioners, who with critical nicety diſtinguiſh theſe waters the one from the other, and carefully confine patients, even of robuſt frames, to ſome few ounces a day of that, that they look upon as the weakeſt impregnation? One comfortable aſſurance, the public has in this inſtance, which it is much to be wiſhed, might be extended to the other therapeutic parts of practice; and that is, that though ſuch practicioners may let their patients die, ſometimes; they can never be ſuſpected to kill them,—with Bath water. Let us now examine theſe ſolid contents, and ſee what they are, and whether they

be ſuch as over turn or confirm our theory of the water and the other experiments made thereupon.

§ 242. 58. As in outward appearances, ſo in taſte, the ſolid contents, by evaporation thus obtained from each of theſe waters, agree: 1. They are in general of a pale aſh color; partly of a gritty or ſoft ſandlike conſiſtency; partly made up of bright ſhining little cryſtals, taken together, with ſome ſenſe of aſtriction, from the terrene parts, which predominate; without making the leſt acrid or lixivial impreſſion upon the tongue. Upon repeting the evaporation of theſe waters at London, in flint-ware baſons, very ſlowly, in a ſand heat, I obſerved the reſiduum, more white and more of a ſaline appearance, than I had before ſeen. I thence apprehended it more ſaline, as it ſeemed all over made up of ſmall, ſhining ſpiculae or little bright needles. But, upon cloſer examination, I found they were onely cryſtals of ſelenite; for, they were inſoluble in water; nor loſſed their form by boiling in it, or even by calcination. Theſe had preciſely the ſame taſte as thoſe obtained at Bath before. 2. Each cauſes an ebullition with all acids, the mineral more eſpecially; 3. With the oil of vitriol, each produces a ſmart ebullition and efferveſcence, with white, acid fumes, agreeing with thoſe of ſea ſalt; 4. Thrown upon an ignited iron or coal, they fume ſlightly, without any viſible flame or acid vapor, without ſcintillating, fulgurating, or crepitating. What muſt have been the caſe, had the notions of GUIDOTT and his followers, of ſulphur and modern nitre in this reſiduum, been true is very obvious to thoſe, who know the compoſition and effects of gun powder. This maſs muſt then have been as combuſtible, as ſalt petre and brimſtone mixed, which is well known to fulgurate and fume, upon the ſlighteſt contact of any igneous body or ſpark. Then if to theſe, the new analyſers fixed alcali were added, he might have learned from the aprentice of any apothecary, that upon throwing the reſiduum upon an ignited iron, or fuſing it in any veſſel, it muſt

have

have taken fire, and gone off with a loud exploſion, ſuch as is produced by that compoſition of ſalt petre, brimſtone, and fixed alcaline ſalt, well known by the name of the fulminating powder.

§ 243. 59. Thirty three granes and an half of this reſiduum, the ſolid contents of one quart of king's bath water, powdered and infuſed in half an ounce of deſtilled water, and raiſed to a boiling heat; the water then decanted and filtrated whileſt hot, and new water added and digeſted, decanted, and filtrated as before; and this repeted to a third or fourth time, in which the water was found to come off quite inſipid; the inſoluble maſs in the filtrating paper, well dried, weighed thirteen granes and an half; which may be looked upon as the proportion of terrene parts contained in the given quantity of this water.

§ 244. 60. The waſhings were ſlightly tinged of a pale, white wine color; being ſlowly evaporated to dryneſs, ſhewed a yellowiſh, oily circle, and left a white ſalt, weighing nineteen granes and about a quarter, ſome being neceſſarily waſted; this is the proportion of ſaline parts in a quart of king's bath water. It may be ſuppoſed to be about twenty granes.

§ 245. 61. Thirty two granes of the reſiduum, being the ſolid contents of a quart of Hot bath water, treated in the ſame manner, as § 242. 58. § 243. 59. give about twelve granes of terrene and about twenty granes of ſaline parts.

§ 246. 62. Thirty five granes and an half of the reſiduum, being the ſolid contents of a quart of Croſs bath water, treated in the ſame manner, as § 242. 58. § 243. 59. give about ſixteen granes of terrene, and nineteen granes and an half of ſaline parts.

§ 247. 63. The earth left in the filtrating paper of each, 1. cauſes ſome ebullition with all acids; and a very ſmall portion diſſolves in them and blunts their acidity; 2. but, the far greater part remanes untouched, and appears in the diſtinct cryſtalline form beforementioned, § 238. 3. 242. 1.—3. calcined in a crucible

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in a wind furnace for twenty minutes, it becomes much whiter; more rough and abſorbent, with ſome ſlight ſenſe of lime-like acrimony; 4. Though before, it yielded nothing more in water; now, it gives the taſte and all the qualities, that lime does to deſtilled water; for the waſhing of it changes ſirup of violets green; cauſes none ebullition with acids, and is rendered milky by volatile and fixed alcalies. 5. Some portion of it is attracted by the magnet, which ſhews the preſence of iron. 6. In order to judge the quantity of calcarious earth and diſtinguiſh it from the the ſelenite, I threw ſix granes of the earth of each water into half a drachm of diluted ſpirit of ſalt, an ebullition aroſe; when the action of ſolution ceaſed, I added ſome drops more of the acid; finding no commotion, I diluted it farther, with diſtilled water, and could then diſtinctly ſee the lamellated cryſtals of the ſelenite, which waſhed and dried, weighed three granes and an half. Hence, we ſee a two-fold earth; the one ſelenitous, the other, two granes and a half of the calcarious earth was contained in the waſhings, which was eaſily diſcovered by alcaline ley, &c.

§ 248. The ſalt being in this proportion, 59. in too ſmall a quantity to examine, I waſhed a ſufficient quantity of the reſiduum to give me ſome drachms of the ſalt; 1. I evaporated theſe filtrated waſhings to a pellicule, and ſet them at reſt to cool and cryſtalliſe. In about twenty four hours, I viewed the liquor and found it partly ſhot into fair, ſmall cryſtalline priſms, that might at firſt ſight be very well taken for nitre; 2. I poured off the non-cryſtalliſed liquor, which was now, of a higher color; evaporated it again, to a pellicule, and ſet it again to cryſtalliſe: It gave ſome cryſtals of the ſame form with the preceding, but much ſmaller, and deformed with ſome ſmall cubical cryſtals of ſea ſalt. 3. The liquor poured off appeared ſtill higher colored; evaporated as before, it ſhewed a thicker pellicule, which fell ſoon to the bottom and remaned there undiſſolved. By this, I ſaw it was

chiefly

chiefly ſea ſalt. I ſet it by to cryſtalliſe; but, had little or no cryſtals of any other kind, than ſea ſalt. 4. I then evaporated the whole to a dryneſs, and found it was moſtly, if not entirely, ſea ſalt; but not perfectly white; having a little of the oily matter to diſcolor it. But, not bittern enough to make it grow very moiſt in the air.

§ 249. As well as the firſt or priſmatic ſalt may be ſeparated from the ſecond or cubical ſalt; for, I can not pretend to do it, with ſtrict exactneſs; the firſt, makes above one third of the whole. So that in nineteen granes and an half, the proportion in a quart of the King's bath water, there are about ſix granes and an half of the firſt to thirteen of the other, or thereabouts.

§ 250. 64. Neither the waſhing of this reſiduum, nor the ſolution of either of theſe ſalts, cauſe any commotion with acids, nor any remarkable change in ſirup of violets. Hence, there is none alcali in bath water, none of the nitre of the antients, and, as we ſhall ſee preſently, none of that of the moderns.

§ 251. 65. 1. The figure of the cryſtals of the firſt ſalt are priſms, ſometimes of four equal ſides onely; ſometimes with one, two, or three of the angles as if it were ſmoothed off; ſo as to give them from four equal, to ſeven unequal, ſides; 2. It's taſte is cold and bitteriſh; 3. It has no ſmell; 4. In warm air, it crumbles into a white powder, which by ſolution may be brought again to a cryſtalline form; 5. It works no change in ſirup of violets; 6. It cauſes no commotion with acids or alcalies; 7. Being diſſolved in pure water, volatile and fixed alcalies precipitate a light, white abſorbent earth from the ſolution; 8. The ſalt fuſes readily and runs very fluid; and 9. If any combuſtible body be thrown into it, or particules of the coal accidentally fall into it, while in fuſion, it does not fulgurate or flagrate, but unites with it and changes it's color to yellow or brown, in proportion to the quantity; whence, it gets a nauſeous putrid ſmell, and a bitter,

a bitter, acrid, offenſive taſte; a ſolution of it is colored alſo, and tinges ſilver, firſt yellow and then black, and by acids, pure ſulphur is precipitated; with a conſiderable increaſe of it's offenſive ſmell. Juſt as in the ſalt of Epſom water, &c.[a]

§ 252. I have been the more minute in this particular, becauſe many groſs and dangerous errors have been committed in this article; in as much as moſt writers and practicioners, that I have met with, not onely attribute ſulphur, but nitre alſo, to theſe waters, and look for the one, as well as the other in the reſiduum. It is plane, that this ſalt, while it has much of the appearance of nitre, wants it's principal, diſtinguiſhing characteriſtics. It indeed anſwers the character of LISTER's Nitrum calcarium, which has not one property of the nitre of the antients or moderns; being to all intents and purpoſes the ſame with this neuter ſalt of Bath waters, a natural bitter, purging ſalt, in all reſpects agreeing with the natural vitriolate, priſmatic ſalt, or with the artificial bitter purging ſalt, known by the name of it's inventer, GLAUBER; whoſe compoſition[b] is an union of the vitriolic acid with the mineral alcali, or baſis of ſea ſalt.

§ 253. Some are very attentive to the extracting ſulphur from the reſiduum of this and ſuch like waters; not knowing that ſulphur when actually diſſolved in water is decompoſed in the evaporation; the phlogiſton flying off, whileſt the acid unites with and ſaturates the alcaline ſalt, by whoſe means it was diſſolved. In order to confirm chemical theory, by experiment, and to be able, from facts, to contradict theſe inordinate lovers of brimſtone, that lodge this mineral, where wiſe nature never placed it, nor art ever found it; and aſcribe to it virtues, which it never poſſeſſed;

[a] Part II. Sect. IV. § 2. &c.

[b] See Idea of Salts, and trial of Simple Waters.

§ 254. 66. I had a mind to follow them in ſome of their own experiments. I fluxed the reſiduum of Bath water with one fiveth part of fixed alcaline ſalt. They readily fuſed, and the mixture, 1. gave an higher color to water, than a greater proportion of the reſiduum alone would have done. 2. The maſs powdered, thrown into ſpirit of wine and gently digeſted, got an higher color, than the ſalt of tartar alone; in that proportion, or the reſiduum alone, could have given. This, ſome of our modern Analyſers leap at, as a proof of the ſulphureous impregnation of the water.

§ 255. But, this comes from the oily ſubſtance in all waters, which readily unites with alcaline ſalts and highthens their colors and thoſe of their ſolutions. And, that it is no ſolution of ſulphur appears from this; that acids cauſe neither ſtench nor precipitation in the above ſolution or tincture; which they muſt have done, had it contained ever ſo little ſulphur.

256. 67. I went further in queſt of this imaginary ſulphur, and hit upon ſomething, that would have given a zealous brimſtone-monger great joy. To give ſuch ſome momentary pleaſure, but to ſatisfy the rational and impartial enquirer, I ſhall relate the flattering proceſs: I took a ſmall clean crucible, weighed it, and noted the weight; this done, I put it into the wind furnace and gradually heated it, to perfect ignition. I then took it out of the furnace, and projected into it, one drachm of the reſiduum. The moſt ſlightly converſant in Chemiſtry muſt ſee, what the conſequence of this experiment muſt have been, had the reſiduum contained the ingredients aſſerted by our analyſers: If it was compoſed of ſulphur and modern nitre, it muſt have flamed and flagrated, as ſoon as the crucible became red hot; if of ſulphur and the nitre of the antients; it muſt have fuſed and given a kind of liver of ſulphur; if antient or modern nitre, pulvis fulminans: but, mark the reſult; It fumed a little, but did not ſenſibly flame; yet, it looked blew for a while; the fumes and vapor, that exhaled, ſtruck

the

the noſe with the ſmell of burning brick; not any thing acid or otherwiſe ſharp or pungent. The crucible, being again placed in the furnace, was again ignited to the highth; when the reſiduum began to fuſe and bubble, and at length run thoroughly liquid; and then, ceaſed bubbling and ſeemed to fix. I then took it out of the fire, and letting it ſtand to cool a little, weighed it. I found it had loſſed about ten granes. It was now hard and ſolid, but broke lamellated. It was hard to diſſolve. I broke it ſmall, poured pure water upon it in a little earthen pan, and gave it a boiling heat. This water was higher colored than the waſhings of the reſiduum, by very great odds; yea more, it ſmelled and taſted like a ſolution of ſulphur; tinged and tarniſhed ſilver, and gave a muddy brown precipitate with a ſolution of ſugar of lead. The advocates for brimſtone will here triumph; whileſt the judicious ſee by what accident this was produced: It aroſe from ſome ſparks of the coal; which, falling into the flowing neuter ſalt, generated ſulphur with it. To be quite ſure of this, I repeted the proceſs, and being more attentive, ſaw the particles of coal, as they neceſſarily muſt, fall into the open crucible. This tends ſomewhat ſo leſſen the weight of the experiment with the reſiduum and ſalt of tartar, § 254. 66. For, the coal, in both caſes, might have given the phlogiſton, which was ſo inconſiderable in quantity before, as to be by none experiment perceptible. To obviate this confuſion, and put the matter out of all doubt,

§ 257. 66. I took the like quantity of the ſame reſiduum; put it into a clean crucible, adapted a cover, and luted it on cloſely with loam; then, placed it in the ſame furnace, covered it over with coals, and kept it in a fuſing heat ten minutes longer than either of the others. Then I took it out, and when cooled, broke it. 1. I found it a ſolid heavy maſs like the others; 2. I diſſolved it like them in pure water, in which I found them not ſo ſoluble, as the preceding, and that it yielded no degree of color, ſmell or taſte like thoſe: 3. It did not

affect

affect ſilver ſenſibly; nor, 4. Did it color the precipitate of the ſolution of lead, as thoſe did, in any perceptible degree. Whence, I judge it will be no preſumption to conclude, that as no ſulphur, none inflammable principle appears by any experiment in the water, in the natural ſtate; ſo is there none of that mineral or phlogiſton to be found in it's reſiduum, upon the ſtricteſt and faireſt examen.

III. *Of*

III. *Of the medicinal virtues and uses of* BATH WATERS.

With all due Deference and Humility,
Submitted
To the moſt Proper Judges,
The ROYAL COLLEGE of PHYSICIANS
of LONDON,
and
The KING and QUEENS
COLLEGE of PHYSICIANS
in IRELAND.

§ 258. FROM a candid view of this analyſis, I hope the judicious will be able to conceive a rational idea of theſe long-famed, though yet unknown, waters. But, in order to bring them as diſtinctly to the point of view, as may be; it will not be an unpardonable prolixity, to recapitulate briefly what has been demonſtrated and obſerved in the courſe of theſe analytical examinations.

§ 259. 1. Let it be obſerved, that the water appears void of the chief active principles aſcribed to it by Doctors JORDEN [a], GUIDOTT [b], and their followers; bitumen, ſulphur, nitre, and a fixed alcali. Every enquiry, every experiment, has been made to illuſtrate thoſe ingredients, and by no trial made by any man whatſoever, even by thoſe, who contend for the water's being impregnated with theſe bodies, before me, nor by any experiment, by me ſince made, does ſulphur in any form, nor any veſtige of the in-

[a] A Diſcourſe of natural Baths, &c. by EDWARD JORDEN, Dr. in Phyſic. With an Appendix by THOMAS GUIDOTT, M. B. 1669.
[b] De Thermis Britannic.

flammable

flammable principle, except in the oily matter, common to all water, appear; and much leſs do they diſcover bitumen. So that not onely by mine experiment, but even by their own, theſe weighty authors are all confuted. But, our new analyſer has found out an happy ſubterfuge for himſelf and his aſſociates: According to him, they do, or they do not, contain ſulphur. In the ſenſe of the word, as it is univerſally underſtood by naturaliſts and chemiſts, he is obliged to confeſs, they are not impregnated with ſulphur. But, according to a new acceptation of the word, invented, I preſume, ſince I firſt demonſtrated Bath waters void of ſulphur, they are poſitively ſulphureous! That is, they contain an unctuous or oily matter, which he would have to comprehend, and be comprehended under the word, ſulphur.

§ 260. But, if this oily matter be ſulphur, and every water, that contains it, ſulphureous, it would be kind of this moſt learned gentleman, it would become his function, to point out a water in Britain, quite void of ſulphur, one, that is not, in his ſenſe, ſulphureous. I ſhould think ſuch a water a greater curioſity, than thoſe of Bath or Aken: For, I doubt, ſuch has never yet been found upon earth, nor dropped from the heavens. At leſt, I will anſwer for it, there is no water in or about Bath or London free from this kind of ſulphur.

§ 261. As for nitre, no more of this, than of true ſulphur is found in theſe waters, by mine experiments, or even by thoſe of them, that aſſert it. If they mean the the nitre of the antients, which was the mineral alcali; the reverſe of it is found. If they mean modern nitre, or ſalt petre, as GUIDOTT does, which is compoſed of a vegetable fixed alcali, and the univerſal acid, ſubtiliſed and charged with phlogiſton by putrefaction; this is not leſs remote from the truth. And all their trials of the reſiduum, as well as mine, ſhew the cryſtalline, priſmatic ſalt thence obtained, to be indeed the Nitrum calcarium, as it was called in a miſtake by

Doctor LISTER; but, this bears no relation to antient or modern nitre; being in fact, none other, than the vitriolate, or bitter, purging ſalt, common in all our purging ſprings, and wherever the univerſal acid and the baſis of ſea ſalt are found to unite; which conſtitute a ſalt, like that of all our purging ſprings; which is analogous to that called, after it's inventer, GLAUBER's.

§ 262. If we enquire, upon rational principles, for the alcali, we ſhall find ourſelves no leſs at a loſs: All poſitively aſcribe it to the waters, and ſome of the moſt celebrated practicioners, reckoning as much upon this, as upon the ſulphur in the waters; call them ſaponaceous and ſulphureous, or ſulphureo-ſaponaceous; than which, nothing appears more foregne to truth and common reaſon. The analyſers, who make this a principal ingredient of theſe waters, have themſelves been made ſenſible of their errors; but, have not had the manhood to acknowledge it, and declare honeſtly their conviction. One of theſe, rouſed by MAYOW's [a] denying the exiſtence of an alcali, as the ſecond probably was by another's denying that of ſulphur in the Bath waters; is forced to have recourſe, as his worthy ſucceſſor has ſince been, to diſtorted definititions: For, while he ſtill hardily aſſerts the water's containing an alcaliſate or alcaline ſalt; he ſubjoins, "under this notion, I take the liberty to underſtand common ſalt, or ſal marine, conſonant to the proper notation of the word: For the ſalt of kali, or glaſswort is marine, though uſed indifferently by the chemiſts for the fixed ſalt, of any vegetables, by calcination." Every lover of truth and phyſic, and of their faithful miniſter and inveſtigator, chemiſtry, will judge this a liberty too great to be conceded in ſuch ſerious and important matters; when it is conſidered, that though kali and every marine weed, as well as ſome land plants, give ſome ſea ſalt by incineration; yet, they always yield another very different, an alcaline, ſalt; of which, Bath water gives not the leſt proof.

[a] Tract cited.

§ 263.

§ 263. But, however bad and ſhameful as this ſubterfuge appears, a ſucceding analyſer has found a ſalvo equal to it, for the non-exiſtence of ſulphur, but inferior to this for the non-exiſtence of an alcali, in theſe waters: for, not preſuming to open againſt the cries of the multitude, as I muſt, from other circumſtances ſuppoſe, he peremptorily ſays, and lays down ſome experiments to prove, that the water contains an alcali: but, before he concludes, this illuſtrious analyſer is obliged to confeſs, that his alcali is none other, than an earth! — Hence, let the judicious and diſpaſſionate judge, what regard theſe famed authors bore to truth, and what degree of credit can be payed to the works of ſuch!

§ 264. 2. Having thus plucked off the unbecoming, borrowed plumes of Bath, as the tinſel, with which vane idolaters decorate ſome lifeleſs maſs for a divinity; when their ſhallow conceptions can form none idea of the true God: Having thus removed ſuperfluities and impertinent appendages, as unnatural, as diſfiguring, as paint or patches to a fair, modeſt, virgin's face; let us now come to the naked truth, and view theſe ſalutary ſources in their native beauty. Let us pull down the altars erected to the unknown divinity, and ſhew the true one, with his own juſt and fit, not fictitious and unbecoming, attributes.

§ 265. If I have not deceived myſelf, it muſt, from the preceding experiments and obſervations, appear, that the component parts of this medicated fluid are, 1. The univerſal ſolvent, water; which muſt be layed down as the baſis of the fluid in every ſenſe, and whoſe exiſtence can admit of no diſpute. 2. This water is, by a pyrite, impregnated with the univerſal acid; partly, in a ſubtil, volatiliſed ſtate; readily flying off from the water; partly, in a more fixed ſtate, ſtanding not onely the native thermal, but additional artificial, heat. 3. This acid renders the water, without it inept, a fit ſolvent for ſuch ſoluble, ſolid, bodies, as it meets in it's paſſage; iron and

an abſorbent earth. 4. For theſe purpoſes, it is not rendered leſs fit, by the imbibition of marine ſalt: 5. From the union of whoſe baſis with a portion of the more fixed univerſal acid, the cryſtalline ſalt, like that called GLAUBER'S, is produced.

§ 266. As the principal materials for this compoſition, ſo the heat to effect it, are ſupplied by the pyrite, which is found in plenty all over the country, and of which the waters bring ample ſpecimens in the ſandlike depoſite, they make in the ciſterns, that cover their ſources.

§ 267. In eſtimating the virtues of any compoſition, the component parts are firſt to be known and conſidered a part; but then, the qualities of the compoſition are not to be deduced from detached individuals, but from the one great whole, that reſults from the union of the particulars.

§ 268. We find then, that every pint of King's bath water, for inſtance, contains, with the fluids, before obſerved, about ſixteen granes and three quarters of ſolid contents; of which, about one thirty-eighth part of a grane is iron; ſomewhat leſs than ſeven granes, earth; leſs than half of which is abſorbent or calcarious earth, above half ſelenite; and about ten granes, a mixed ſalt; of which, near a third is native, vitriolate, or GLAUBER'S ſalt, the reſt ſea ſalt; all found united in a fluid, heated about twenty degrees above the blood of man, in an ordinary, healthful ſtate. How far the reſt recede from this may eaſily be calculated.

§ 269. Now, from a mixture of ſuch component parts, in ſuch proportions, in a vehicle ſo heated, what is to be rationally expected? Whoever would receive a rational anſwer to this queſtion, muſt turn back to what has been ſayed of the uſes of warm ſimple water [a]. As this is the great common ingredient, the baſis, which all the medicated waters hold in common with the ſimple, it is in this, their principal concord is to be

[a] Part I. § 371. § 420. to 501. § 524. and following.

ſought

ſought and found. Whatever warm water, charged with theſe like ingredients can do, that, and that alone is to be expected from Bath water. He muſt be involved in clouds of ignorance, wrought up to a great pitch of enthuſiaſm, or actuated by the moſt mean, knaviſh craft, that goes any further.

§ 270. What then do the practical writers teſtify of theſe waters?—Hitherto, they have not been diſtinguiſhed, by any native or forregner, that I know of, from thoſe of Aken, or any other confeſſedly ſulphureous waters. And ſome body, who gives us but the initial letters of his name, in the year 1676, draws a parallel between the waters of Bath and thoſe of Aken; in which, he attempts to ſhew ſome relation in the etymology of the name of each; ſome ſimilarity in the ſituation and buildings of the cities[a]; in the number and names of their baths; the affinity and cauſe of their impregnations; the commodities and entertainments of both; and ſets forth many ſuch like circumſtances, with more poetical elegance, than phyſical juſtice.

§ 271. Yet, from no better authority, that I can diſcover, are all the qualities and virtues of the waters of Aken attributed to thoſe of Bath.

§ 272. In order to judge aright in this matter, let the analyſis of Aken and Bath waters be but curſorily compared; by which it muſt evidently appear in what they differ or agree.

§ 273. 1. Theſe baths have evidently one common baſis, ſimple water; heated by ſimilar means, an ignited and decompoſing pyrite, with the volatile parts of which, the one is impregnated, by the water's running over the heated pyrite, without coming into contact with it; whileſt the other, by running at the bottom or lower part of, or through the like pyrite, poſſibly leſs ſulphureous, or being delivered at a

[a] Bathon. et Aquiſgr. Thermar. Comparatio, variis adjunctis illuſtrata. R. P. Epiſt. ad Rogerum Caſtlemaini comitem. 7 Kalend. Aug. 1675.

greater diſtance from the heated mineral, appears charged chiefly with the more fixed parts. With reſpect to heat, this appears in different degrees; the ſource of the Emperor's bath in Aken raiſing the mercury in the thermometer to 136[a]; the pump of the King's bath at Bath[b] to 119, in the pump room; 120 in the bath.

§ 275. 2. They have an acid much of the ſame nature, more volatile in Aken[c], partly volatile, but moſtly fixed at Bath. § 130. 150. § 179, to 225.

§ 276. 3. Aken water depoſites a pale earthy matter, which grows black in it's ſewers[d]; Bath a yellow martial or ochrous earth. § 88. 1. 107.

§ 277. 4. A phlogiſton or ſubtil inflammable principle, paſſing generally with vulgar obſervers, and pretending analyſers of waters, for ſulphur, when it is in fact but one of it's conſtituent parts, is evident to the ſenſes, and proved by various demonſtrative experiments in Aken[e]; But, this can in no ſhape be ſhewn in Bath waters, by any experiment, that has yet occurred to the favorers of this opinion, more than to me; whereas it's defects appears by many inconteſtable proofs. § 87. 2. § 138 to 145. § 218. § 223. § 224. § 225. § 238.

§ 278. 5. The ſolid contents of the Emperor's bath at Aken[f], are from thirty ſeven to fourty granes in a pint; of which, about an eleventh part is an abſorbent earth, with ſome ſelenite, the reſt a twofold ſalt, partly purely alcaline, and partly muriatic; whileſt the contents of the ſame quantity of King's bath water at Bath, are but about ſixteen granes and three quarters; of which, about one thirty eighth part of a grane is iron; ſomewhat leſs than ſeven granes earth, partly calcarious, and partly ſelenite; the reſt, being ten granes, conſiſting of about one third Glauber's ſalt, and two thirds

[a] Aken, § 170. [b] Bath, § 92. 5. 96. 97. [c] Aken, § 183, 184, 185, 186. § 270 [d] Aken, § 166, &c. [e] Aken, § 185 to 191. and following, § 206 to 223. [f] Aken, § 327. 2. § 333, 336, 337, 338,

ſea

ſea ſalt, without any proof of an alcaline ſalt, or nitre, or ſulphur. § 236. 55. and following.

§ 279. Now, notwithſtanding the cleareſt diſparity, by ſome moſt unaccountable infatuation, do all the writers and all the practicioners, I have ſeen or heared touch upon this matter, whether at Bath or elſewhere[a], attribute the ſame properties, qualities and uſes of theſe waters, as the antients or moderns aſcribe to any of the moſt powerful nitrous or ſulphureous, or nitro-ſulphureous waters to them known: For, to explane and aſcertain the qualities and uſes of Bath waters, GUIDOTT, who has ſince his time been juſtly looked upon, as the chief of the writers upon this head, hardily quotes PLINIUS, AGRICOLA, BACCIUS, FALLOPIUS, KIRCHERUS, BAUHINUS, and others, and whatever they aſcribe to ſulphureous or nitrous waters, he applies to thoſe of Bath; when, by every juſt trial, even by his own experiments, had he underſtood them, he muſt have been convinced, that they have no more relation to each other, than the liquor now uſed at Bath to tinge ſilver yellow, bears analogy to the Bath water; to which, the producing of that effect is, and has long been, falſely imputed.

§ 280. This gentleman likewiſe, to confirm his opinions and practice, cites his contemporary, as well

[a] Since I wrote this eſſay, I have had the ſatisfaction to find ſome illuſtrious exceptions to this aſſertion; which juſtice and truth authoriſe, if not oblige, me to ſet forth; though I fear, it may offend the modeſty of the gentlemen, to be thus publicly mentioned. I mean the learned and eminent phyſicians following; Doctor TAYLOR, who worthily fills the place of one of the phyſicians to his Majeſty, Doctor WINTRINGHAM, well known by his works; Doctor WATSON, all of the Royal Society and Royal College of Phyſicians of London: as alſo Doctor SUTHERLAND and my generous, candid friend Doctor BAYLIES of Bath; to whom I believe I may venture to add, Doctor DAVIES of the ſame; a gentleman, the loſs of whoſe acquaintance, I muſt lament; becauſe he is repreſented to me as a man of good ſenſe, learning, and ſcience, and of mine opinion, by a perſon of the firſt rank, to whoſe judgment and probity, I muſt, with the multitude, ever pay the utmoſt deference and reſpect. If I omit doing the like juſtice to others, it muſt be imputed to ignorance, not deſign.

as preceding writers and practicioners at Bath; ſuch as TURNER, JONES, JORDEN, VENNER, and others; who all agree in aſſerting, that, from earlieſt antiquity, the waters of Bath were famous in external, as well as internal application, for ſpots, pimples, puſtules, ſcald-heads, ſcabs, ſcales, tetters, bilious eruptions, and other cutaneous foulneſſes; and even for ſtrumas and ſcrophulas, the various kinds of the evil; for the ſcurvy and leproſy, and for ulcers and apoſtemations; as alſo for the firſt as well as laſt ſtages of the venereal diſeaſe; for gouts, contractions, or rigidity of the joints or members; for rheumatiſms, palſies, ſpaſms or cramps; for tremors, apoplexies, epilepſies, lethargies, loſs of ſenſe and memory, impediments of ſpeech, coldneſs of the brain, and other diſorders of this claſs; likewiſe for defluxions, rheums, or catarrhs, the mur, various kinds of hoarſeneſs, coughs, and other pulmonic diſorders[a], as our author adds, of the vapor, "from the ſulphur it contains;" as alſo for weakneſs and running of the eyes; for noiſe and running of the ears; for the ſtrangury, gravel and ſtone; diabetes and teneſmus; for colics of various kinds; for different fluxes and the piles; for intermittent fevers; for tumours and indurations of the ſpleen; for coldneſs, induration and obſtructions of the liver; for ſchirrus in general; for flatulency in the bowels; for hypochondriac and hyſteric paſſions; for ſterility, whether from an hard and inflexible rigid ſtate of the fibres of the womb, or from their relaxation and coldneſs; for cold phlegmatic diſorders, ſuch as dropſies, anaſarcas, oedemas, and the chloroſis or virgin's diſeaſe.

§ 281. This moſt induſtrious and laborious writer, after ſpending ſome pains in endeavoring to acquit the waters of ſome ſuſpicions of evil effects to be apprehended from the bitumen and ſulphur attributed to them; by ſhewing the nitre to predominate, though

[a] De Therm. Brittanic. p. 215.

not a particule of either can be ſhewn in them; procedes to illuſtrate the virtues above mentioned in the waters, taking care to inform us, of two great events which he ſeems to have judged of conſequence enough to deſerve a place in the recital of the virtues of theſe waters; the one, a lambent flame, perhaps a glory, though not exceding the blaze of a farthing candle, playing about the ſacred perſon of ANNE, queen conſort of that illuſtrious monarch of Great Britain, JAMES the firſt, of bleſſed memory; taken from JORDEN; the other, the happy arrival of her royal highneſs, Princeſs ANNE, daughter of his moſt ſacred majeſty JAMES the ſecond, monarch of Great Britain; whom he might have ſtiled, of moſt unfortunate memory; with the moſt illuſtrious hero, GEORGE Prince of Denmark, her royal conſort, at Bath, for the benefit of bathing, and drinking the waters; and this within the Doctor's own knowledge. How much this excedes the ſtile of a common jugler or rary-ſhewman, who always takes care to tell, he had the honor of playing his pranks before the whole court; let any body judge. But, to procede.

§ 282. This indefatigable man, laboring, with Herculean ſtrength and Penelopean induſtry, againſt all the rules of phyſic and chemiſtry; againſt a moſt heavy genius, and againſt common ſenſe; takes up a conſiderable part of his maſſive volume with recitals of cures, performed by the bathing and drinking of theſe waters, in an endleſs variety of the diſorders before recited, and ſome others: In which, he ſcrupulouſly ſets forth the name, ſurname, ſometimes the age, and now and then the genealogy of the patient; ſeldom forgetting to tell his country, his titule or profeſſion, and the place of his abode, ſo preciſely, as to the name of the ſtreet or lane, and the ſign in London, or any other city where he lived; without giving, what ſucceding practicioners muſt have been moſt intereſted in knowing; the ſigns, ſymptoms, or any other circumſtances, of the diſeaſe, than barely the name, which the doctor, or perhaps the patient, thought fit to give it.

§ 283.

§ 283. Every judicious perſon muſt know, that hiſtories of diſeaſes and their cures, muſt prove moſt egregiouſly conducive to the improvement of the healing art. But, unleſs the diagnoſtic ſigns and ſymptoms, with the other particulars of the caſes, be moſt minutely, circumſtantially, layed down; unleſs their riſe and progreſs, to the time of undergoing the curative courſe, and the particular ſtate of the malady at that time, be ſuccinctly related, and the courſe fairly ſet forth, to the utmoſt exactneſs; no man can pretend to draw any certain inferences from millions of ſuch ſuperficially, uncertainly, and indeterminately related cures.

§ 284. The ſame diſorder ſometimes ariſes from different cauſes; and therefore requires different treatment. GUIDOTT's Panacea might cure one patient, and kill another, in the ſame diſorder. Yea, like other medicines, may prove proper and improper for the ſame patient, in one and the ſame diſtemper, at different times; from the endleſs viciſſitudes of circumſtances, to which the human frame is ſubject. The excellence of the phyſician, the difference betwixt him and the quack, appears in none inſtance more clearly, than in making a juſt diſtinction in theſe points. Before this phyſician, whoſe works are compoſed of an indigeſted maſs, a chaos of errors, or even the moſt accurate, judicious and faithful, can be intituled to any degree of credit in ſuch matters; the caſe of the patient, tracing it from the earlieſt origine in the anceſtors, not omitting any material circumſtance relating to it, ſhould be moſt minutely layed down, and then the method of cure with no leſs exactneſs, not omitting any variations in doſes, times or manners of adminiſtring it, or a ſingle inſtance of it's good or bad ſucceſs. Without this, we can have no more certainty of being right in our judgements of the nature of the diſeaſes or their cures, than the overgrown head of the quacks, that reproach our age and thin the ſtate; who, with more candor than ſenſe, declines examining the duped patient,

tient, that applies to him, in any particular; and even refuſes to hear any further relation of the diſorder, than the bare name, given it by the ſufferer, or a curſory recital of the complaint at the moſt; and thereupon, gives one of his pretended ſecrets, in the ſame manner and doſe, to both ſexes, of all ages and conſtitutions, in all ſeaſons of the year indiſcriminately. What aſſurance can we have, that either did or does know, more than they deſcribed, the diſtemper?—And ſuppoſing the diſorder known, and Bath water adminiſtred, as we have lived to ſee it, either in ſuch inſignificant quantities, or ſo altered with incongruous drugs, that it can produce no certain effect; we ſhall find ourſelves as far from the truth as ever; or, if we could come at it, ſhould find, that the cure, which was performed more by chance, than deſign, through the ill-judged interpoſition of a motly medly of ſhop-medicines, or, which oftner happens, that the cures wrought by the ſtrength of nature, able, at once, by her native powers, to overcome the diſorder and the medicinal obſtacles, not helps, thrown in her way; has been attributed to that, that bore the leſt ſhare in the ſalutary change.

§ 285. If the former ſhould, the latter certainly can not, admit of any doubt; becauſe, by Dr. GUIDOTT and his predeceſſors' precepts and examples, the uſe of ſuch medicines are authoriſed, as have been already made to appear in the experiments, greatly to alter the nature of the water, if not totally to decompoſe it; to make it's effects uncertain, or to render it as ineffectual as poſſible: Theſe are done by the mixture of mineral and vegetable ſalts; ſuch as acids and fixed and volatile alcalies, diuretic and purging medicines, and the endleſs catalogue of the moſt complicated and perplexed compoſitions, that ignorance, the parent and nurſe of empiriciſm, can prompt: For the truth of this, let the antient and modern practical diſſertations upon this ſubject be viewed; let the voluminous records of the numerous apothecaries' ſhops at Bath be examined,

or

or the curious collections of the recipes of modern practicioners, ſince Dr. GUIDOTT's time, hoarded up in families, for the good of themſelves and their poſterity, be turned over; or let their patron's pompous, ponderous work[a] be looked into; where, it is never ſo much as hinted at, that theſe waters ſhould be uſed without, what they are pleaſed to call, "an appropriate courſe of medicines;" though in general, they be nothing leſs, than the diametrical reverſe of proper.

§ 286. But, ſhaking off the prejudices of ignorance and enthuſiaſm, and getting clear of this confuſed empirical practice, which is eaſily and univerſally done, by expoſing it; let us ſee what, from ſound reaſoning, upon fair experiments, may be expected from Bath waters.

§ 287. I would not be thought deſirous to diveſt theſe ſalutary ſources of their virtues, nor by any means to decry them. Yet was I pointed out at Bath to the populace as a man come to deſtroy the waters. So that I have learned, that I narrowly eſcaped the inſolence, or worſe abuſe, of an inraged rabble. Let the world judge, whence this danger? Whence this dread of the diſcovery of truths, in which mankind is ſo apparently intereſted? I wiſh I could increaſe and multiply their virtues, for the common good of mankind, and for the particular advantage of the onely country, in which I can enjoy the ineſtimable ſweets of liberty, the beſt gift of Heaven; that ſum of mortal comforts; without which, I ſhould judge life but a liſtleſs burden. I onely mean to make them more thoroughly and univerſally beneficial, by explaning the principles, upon which alone they can act, and thereby ſhewing what they may, and what they may not effect.

§ 288. This can beſt be done by a comparative analyſis, ſuch as I have endeavored to give, and which, I hope, will be found juſt, as far as it is completed in the preceding ſheets. Such as attend to this, till they

[a] De Therm. Brittanic. p. 271 et paſſim.

receive

receive better information, will not judge of the effects of theſe waters, from what has been ſayed of others, which are actually found, though not commonly reputed, quite different; nor determine the qualites of thoſe by theſe.

§ 289. Whatſoever diſorders may be relieved by dilution with warm water, charged with a mineral ſpirit of the acid kind, with a more heavy acid of the vitriolic kind, and by their means, impregnated with a very ſmall portion of iron, a conſiderable quantity of abſorbent earth, and ſelenite, with a little ſea ſalt, and leſs Glauber's ſalt; I ſay, whatever ſuch a compoſition, moſt exquiſitely performed by the inimitable chemiſtry of nature, may, Bath water muſt, effect; but no more.

§ 290. Whatever diſorders then, derive their origine from an acrimony, not aceſcency, of the juices; whatever diſorders ſpring from an alcaleſcency of the humors, ſuch as a redundance or preterntural acrimony of the bile, with putreſcency in the fluids or bowels; there, the feveriſh commotions being previouſly allayed, Bath waters will be found a ſovereign remedy.

§ 291. But wherever, if ever, it has been found ſerviceable in oppoſite indications; there, the effects muſt be attributed to the predominancy of the watery element, with the little pittance of iron, which it contains.

§ 292. Thus, for example, when GUIDOTT, or any of his ill-inſtructed followers, tells us, and by inſtances demonſtrates, that theſe waters cure that uneaſy ſenſation, which is cauſed at the upper orifice of the ſtomach, called, from an imaginary affection of the heart, or vicinity to that bowel, cardialgia, in our language, the heart-burn, or heart-burning; he may be intituled to attention and credit; but, when he attempts to account for the cauſe, and places it in acidity, and for the effect, and aſcribes to it an alcali, which is not to be found in the water, or to the abſorbent earth, which upon the diſpelling, or otherwiſe ſaturating the predominant acid,

acid, is ſeparated from the water, and then acts it's natural part, but not otherwiſe; he is to be laugh'd at, and contemned. Firſt, for not diſtinguiſhing the cauſes of the diſorder; ſecondly, for building upon non-entities, alcalies; of whoſe exiſtence in the water, no ſort of proof is, or can be offered; the reverſe upon every trial being ſhewn; thirdly, for imagining, that an abſorbent earth, diſſolved in any liquor by the means of an acid, as it muſt, and can not otherwiſe be, in Bath water, can produce any effect in any wiſe relating to what it did before ſolution; becauſe, the very action of ſolution implies at leſt ſaturation or neutraliſation; if the acid ſhould not, as it is found in this inſtance to, predominate.

§ 293. If then, this abſorbent earth, thus diſſolved, be, as it muſt be, when the acid does not predominate, in a neuter ſtate; it can not, as it might before ſolution, abſorb or blunt the acidity, which cauſed this diſorder; and much leſs can the liquor, in which it is diſſolved, and which is found ſurcharged with an acid, produce the aſſerted effect. How then is this paradox ſolved? This ſeeming contradiction reconciled to ſenſe and truth?—This it is by conſidering, that this, as well as other like painful ſenſations, in the ſtomach and inteſtinal channel, are produced, as well by the ſuperabundance of alcalies, as acids; by the preternatural acrimony, or redundance of choler. For theſe, Bath waters are indeed found a ſpeedy and effectual remedy, which they could not poſſibly be, but muſt be the reverſe, had the waters been bituminous, ſulphureous, or alcaline. But, they are, as they have been demonſtrated, ſubacid; they muſt then, as they are found to do, dilute the choler, by the watery element; obtund it's acrimony, by the acid; and promote it's expulſion by the ſalts, they contain. Upon theſe principles, theſe excellent waters will be found to act in all the other caſes, wherein they have been fairly found to be beneficial. And it is moſt evident, from theſe conſiderations, that they could not really have been

been found uſeful in their ſeveral inſtances, by this author and his pupils layed down, had they contained the ingredients which he and they ſuppoſe.

§ 294. As then, the acrimony and redundance of choler muſt be effectually remedied by a diluting ſubacid courſe; it is eaſy to conceive how and why Bath waters ſhould be found of ſuch efficacy, as is obſervable, in the almoſt infinite variety of other diſeaſes, that derive their origine from this ſource; or are evidently complicated and perplexed with an exceſs of this juice, whether in an healthful or in a vitiated ſtate.

§ 295. Bath water, then, is to be conſidered as a warm, ſubacid, chalybeate water, rendered deterſive and aperitive by a native, neutral bitter, and a muriatic ſalt. It differs from our purging chalybeates in nothing more, than heat and the proportions, not the qualities, of their ingredients; and it's operations and effects are to be rationally accounted for upon theſe principles, and upon none other. Theſe alike curdle milk, and anſwer in ſome degree all the trials of Bath water. Here then, it may be proper to point out the errors of thoſe, who direct, in very emaciated and infirm habits, the taking milk mixed with theſe waters, as it is recommended to be taken with certain waters by HOFFMAN. Nothing ſurely, but a ſenſible defect in the gaſtric juice, can juſtify this practice; ſince it is univerſally known and confeſſed, that Bath waters coagulate milk. Few weak ſtomachs may be found able to digeſt ſuch a poſſet, of which, prudence therefore, forbids the general uſe.

§ 296. In all choleric complaints, whether their effects be felt in the firſt or ſecond paſſages, or upon the ſurface of the ſkin, in the variety of eruptions and foulneſſes, that come under the denomination of bilious; in the putrid and alcaleſcent ſtate of the juices, attending a long continuance of theſe diſorders; or brought on by foul, luxurious feeding, upon putrifying animal food, with ſharp, hot ſauces, the modes of our wiſe and polite days; by conſequent putrid fevers;

or

or by long voyages at ſea, wherein men are generally forced to live upon ſalt and ſtale proviſions, unwholeſom beverage, and foul air; in the rheumatic and other ſharp pains in the bowels and limbs, attending theſe complaints; in ſpaſms, palſies, hypochondriac and hyſteric paſſions and other nervous diſorders ariſing from this cauſe; Bath water muſt prove one of the beſt remedies within the compaſs of human knowledge, as it muſt dilute the humors, blunt and correct their acrimony, reſiſt their putrefaction and promote their expulſion by the proper emunctories; and, at the ſame time, tend to brace up the ſolids to the natural tone.

§ 297. Hence, it is eaſy to conceive, in what a variety of caſes, Bath waters may be rationally and ſucceſsfully adminiſtered. But, if we procede according to the received notions of the impregnation, and modern modes of practice, we may take in the endleſs train of maladies, incident to the human race; as fit ſubjects to ſhew the ſanative efficacy of theſe waters; an abſurdity which every ſenſible man muſt avoid and deteſt.

§ 298. When I point out in general terms, the diſorders in which the waters of Bath may prove ſerviceable; I would be underſtood to mean theſe waters, uſed after proper preparation, without complicating or altering their nature by the admixture of any foregne matter whatſoever. And, when any man carries it further and extols them as a panacaea, a fit cure for diſorders of oppoſite ſymptoms and ariſing from contrary cauſes; if he means any thing, it muſt be by the different combinations of the waters with other medicines. He may then, as well take any other water for the baſis of his courſe, and compound it to his mind. Thus, ſome find good effects from taking various alcaline medicines or ſope with the waters. Yet, all theſe decompoſe the waters! To judge which produces the effect, we muſt learn which and in what proportion it predominates. But, if there be a perfect

fect ſaturation; then a neuter ſalt is produced; which muſt work the like effect, with any ſimple water, any where, as well as at Bath. Let the ſope-mongers hence learn not to counteract their boaſted agent.

299. It is certain, the operations and effects of the moſt powerful remedies depend upon the proportions and manners, in which they are given: Thus, vomits may be rendered purgatives, and purges vomitives; and either may be changed to ſudorifics. Thus, Ipecacuanha may be made to act as an aſtringent and diaphoretic, and aſtringents may become, in ſome caſes, purgative. And likewiſe, opium is found to cauſe ſleep or the reverſe, according to the different management and cuſtom introduced.

§ 300. Thus, it muſt be confeſſed, Bath waters may ſometimes be found ſerviceable, where they do not at firſt ſight appear indicated, but rather the contrary. How can Bath water's being found uſeful to gouty and nephritic perſons, as in ſome inſtances it has been, be accounted for, upon the principles layed down?—In mine apprehenſion, it can onely be done in this manner: Simple dilution is the baſis of every known remedy in theſe diſorders. A compound fluid, whoſe ſolid contents are but about ſeventeen granes in a pint, can not be ſuppoſed void of that requiſite. The ſolid contents, eſpecially the terrene, which make about twelve parts of the ſeventeen, can not, in this vehicle, be of any ſort of ſervice, and may poſſibly be the reverſe; by increaſing the calculous matter; and the acid muſt tend to thicken the juices, and conſequently, to lay a foundation for an increaſe of the malady. Yet, the patients are confeſſedly relieved!—but how?—If by ſuperabundant bile, the ſtomach and bowels have been irritated and weakened, the apetite and digeſtion vitiated, the ſecretions and excretions diſturbed or interrupted; whereby the gout is rendered irregular; Bath water, agreeable to our theory, will eaſe and ſtrengthen the ſtomach and bowels, reſtore the loſſed functions, and ſoon after bring on a regular fit;

which being the criſis, by which the diſorder is relieved, the patient neceſſarily grows better, eaſier and ſtronger, than for ſome time before he could have been. In this ſalutary change however, the watery element bears no ſmall ſhare; as has been explaned in treating of ſimple warm water [a]. And upon the ſame principle, do theſe waters become uſeful in ſome particular nephritic caſes, without being therefore juſtly to be enumerated among the fit medicines for the ſtone, gravel, or gout.

§ 301. To me then, it planely appears, that the waters of Bath are moſt effectual, moſt excellent remedies, in all diſorders, that ariſe from the reverſe of acids; choler or bile, or an alcaleſcency in the juices, and vices thereto conſequent, induced in the ſtate of the ſolids; for which, they could not poſibly be found proper, had they, as has been long falſely imagined and aſſerted; been charged, like ſome of the baths of the antients, to which they are unjuſtly compared, with bitumen, ſulphur or nitre; the contrary of which, both from theory and practice, appears.

§ 302. The uſes of this water are two fold, 1. internal, 2. topical or external.

§ 303. 1. In the firſt, it's effects depend upon the proportion and manner, and the particular habit of the ſubject, in which it is adminiſtred. If ſuddenly drank, in large draughts, it will purge; partly by it's gravity, as moſt ſimple waters act, and partly by it's ſalts, though ſmall in quantity. From the ſame cauſes, it paſſes powerfully by urine. When taken in ſmaller quantities and more ſlowly, eſpecially without taking the accuſtomed proportion of common diluting fluids; it cauſes coſtipation, ſome ſenſe of heat, and an heavineſs in the head, with a propenſity to ſleep, particularly at firſt taking it.

§ 304. The manner and times of taking the waters of Aken, are ſuitable to this, as well as to other baths.

[a] Part I. § 501. § 524, &c.

Like

Like that, and under the ſame regulations, it may be properly taken at any time of the year; ſo that the laying out certain ſeaſons, in which alone it is to be uſed, may be enumerated among the ſhameful errors and extravagancies, that have long diſgraced the practice, as well here as there.

305. As to the doſes of the waters, theſe are as much miſtaken, as their compoſition till now has been. Theſe depend upon the habit of body and diſorder of the patient. In all medicated waters, the beſt general rules are to begin with ſmall quantities; ſuch as from four to eight ounces, and encreaſe them gradually at proper intervals, without offending or overloading the ſtomach or inteſtines; continuing them for a certain time, according as they are found to produce the deſired effects, and then diminiſhing that quantity by the ſame ſlow degrees, by which it was raiſed to this pitch; as in treating of the internal uſe of Aken waters, has been layed down, from § 454, to § 457: For, though theſe waters be found fit for contrary indications to thoſe, for which our Bath waters are proper; yet the ſame rules, in adminſtring and doſing, and the ſame regulation of the non-naturals, during and after the courſe of the one and the other, will be ſtrictly neceſſary to each; to avoid repetitions of which, I refer the reader to the eſſay on Aken water, § 460. to § 468: Adding this caution, that the quantity of ſolid food in general, of vegetables in particular, be more ſparing at Bath, than at Aken; for reaſons frequently offered under the various preceding experiments and obſervations; to wit, that as theſe waters are found to impede the dreſſing, ſo they may obſtruct the digeſtion, of ſuch bodies.

§ 306. I muſt remark, that the doſes commonly given of Bath waters, with or without the medly of medicines uſually mixed with them, can be found of very little real benefit. Let any ſenſible man, however unaſſiſted with phyſical reaſoning, but judge what can be effected by a pint of water warmed and impregnated to the pitch pointed out in Bath water? — what is to

be expected from the proportions of the ingredients of this compoſition, jointly or ſeparately taken? — The water of almoſt every common pump, contains in general almoſt as much earth, as any of the waters of Bath; and ſome ſalt, partly of the ſame nature, leſs indeed in quantity. No man, that drinks water, baulks at a pint, two or three of ſuch a water in the day. The addition of a mineral acid, with a ſmall proportion of another neuter ſalt and a very ſmall quantity of iron, muſt undoubtedly make ſome difference; yet, not ſurely ſuch, as can authoriſe the confining patients, even of the robuſt kind, to a pint a day for months, and much leſs to three or four ounces a day, two or three times a week, as is frequently the caſe at Bath! The more antient, who certainly were not much more ignorant of the nature of theſe waters, nor leſs empirical, than the more modern practitioners, gave their patients more of the waters, and leſs ſhop medicines, than their ſucceſſors. The former gave them hardily, from a pint or two at a time, to five, ſix, eight or ten pints a day, at proper intervals, according as the ſtomach and bowels would bear them, without offenſe or inconvenience to the patient. And, if their records bear truth, which even their diſſenting followers are forced to confeſs, the practice of thoſe, who gave them thus by the pint, was attended with infinitely greater and better ſucceſs, than can be boaſted to attend that of thoſe who have ſince meaſured them out ſtrictly by the ounce.

§ 307. All extremes are bad. And, as nothing is to be expected from the puiſnè pittance of the more modern practicioners, than what they themſelves ſeem to look for; the detaining the patients at Bath, to favor the opportunity of giving plenty of other medicines; ſo on the other hand, ſome miſchief may be dreaded from large and ſudden draughts. I think, they had beſt be taken at half a pint at a time, at convenient intervals, as far as four, ſix, or eight ſuch glaſſes in the forenoon; one or two at an hour or two's

diſtance

diſtance before dinner; and as much about the ſame time before ſupper. Rarely, if ever at meals, as they can but ill, if at all, aſſiſt digeſtion.

§ 308. It behooves the more weakly and delicate, to be more cautious in commencing a courſe of theſe waters. And none ſhould take them, without previouſly emptying the firſt paſſages, with ſome ſimple, ſaline or manna purge. Thoſe of tender frames will find it beſt to begin with one of the cooler waters, as that of the Croſs bath, for example; and at firſt, take no more than a quarter of a pint at a time, and not above a glaſs or two a day, for ſome days; then, increaſing it gradually, inſenſibly to the quantity requiſite; and then, gradually exchanging it for the hotteſt, where that is found neceſſary; and after taking it thus, the ſtated time; diminiſhing the quantity, and changing the water, in the ſame order and proportion, in which it was augmented.

§ 309. Here let me obſerve, that inaction and cloſe confinement is rarely, if ever, ſuitable to a courſe of theſe waters. How ſhocking then muſt it be to ſee patients, who ſhould, during their drinking theſe waters, be kept in gentle motion, in the ſhade in ſummer and under cover in bad weather, packed up in the pump-room ſo cloſely for hours, that they can ſcarcely move or breath? Who is intruſted with the care of health, that has an eye beyond his fees, can ſee this, and other ſhameful abuſes, without crying out for a ſpeedy reformation?— Let the gentlemen, who arrogate to themſelves an haughty ſuperiority to the reſt of the profeſſion, the Regular and Rational ſages of Bath, anſwer to theſe quaeres if they can.

IV. *Of the Topical Uſes of theſe Waters.*

Preſented,
With due AFFECTION and RESPECT
To his much admired, facetious Friend,
Mr. CHAMBERLAINE,
Chirurgeon, of London.

§ 310. THE external uſe of theſe waters might be three fold, had they been rightly conducted; whereas now, they are onely two fold; to wit, the general bathing and the partial, or the pump; to which, might be added a more effectual than either, the vapor bath, now totally neglected or unknown.

§ 311. The long prevaling ignorance of the compoſition of theſe waters, introduced the ſame error in the external, as in the internal uſe of them.

§ 312. Every writer upon Bath water, and every practicioner there, as well as elſe where, who preſcribes it, promiſes himſelf and his patients the ſame effects from this, that the antients found from their nitro-ſulphureous waters; ſuch as the Baths of Aken now produce. But, as thoſe are now demonſtrated to agree with theſe in little more, than merely the elementary fluid and heat; ſo, they can onely concurr in the common effects of theſe, and muſt in other reſpects diſagree, according to the diverſity of their ſeveral impregnations.

§ 313. Had this been duly weighed, before a very learned and ingenious practicioner of this age, expended much good ſenſe and phyſical knowledge in a practical eſſay on the uſe and abuſe of warm bathing; we might have expected a finiſhed diſſertation, founded upon true principles, not built upon the groundleſs

leſs notion conceived; to wit, "that the ſaline, ſulphureous and ſaponaceous particules, manifeſtly contained in the Bath waters, muſt render theſe more penetrating, and more powerful ſolvents, than common water." For, if theſe ingredients, eſpecially the ſecond and third are not to be found in the waters, as muſt now be confeſſed, the very reverſe of ſope planely predominating; Bath water can not be as good a ſolvent, as common warm water. Therefore, this tract, whileſt it appears full of juſt reaſoning, will be found but a baſeleſs fabric.

314. As this is now demonſtrated to be a ſubacid, charged, hard water, no man can be ſo abſurd, as to ſuppoſe, with the writers and practicioners till now, that it can correſpond in lixivial or ſaponanceous, reſolvent and abſterſive qualities with the truly nitrous or nitro-ſulphureous baths. On the contrary, inſtead of ſoftening, relaxing and cleanſing the ſkin, and opening it's pores, as lixivial waters muſt do; it muſt harden and brace up the ſolids, prevent the cleanſing of the ſkin, and tend to obſtruct the pores; and it does ſo; as far as the common baſis in which all baths agree, the warm water, and the common practice of ſtaying in, till the effects of that predominate, can admit.

§ 315. As far then, as a warm bath can be a tonic application, a bracer of the ſolids and a conſtringer of the pores, Bath waters charged with an acid, and by it's means, with ſome iron and much earth, muſt brace up the ſolids, and conſtringe or otherwiſe obſtruct the pores. Whence, it is by no means to be conſidered in the ſame point of light with the waters of Aken or Borſet; for, as theſe may be ſerviceable in many caſes, where thoſe would be improper if not dangerous; ſo thoſe may be uſed with propriety and efficacy, where theſe may be of no conſequence or perhaps hurtful.

§ 316. Wherever then, warm bathing is found proper, in a relaxed ſtate of the fibres; there the baths of

Bath, under a regular oeconomy, muſt certainly be preferable to any, within my knowledge any where.

§ 317. But, as they are capable of obſtructing the pores, by which the greateſt and moſt important diſcharges of the human body are conſtantly made, in an healthful ſtate; they can not be adminiſtered with too great care and caution, nor without juſt preparation.

§ 318. The general cautions and preparations before layed down for ſimple and medicated baths, is more ſtrictly to be obſerved here, than ordinary. Evacuations are in general to be premiſed to a courſe of bathing in theſe waters. And the drinking them ſome days previous to bathing and ſometimes in the bath, will be found very ſerviceable, where the cutaneous diſcharges are not already redundant and are intended to be kept up. If particular care be not had in the adminiſtering theſe baths with due preparation, neceſſary caution, and ſtrict regularity during the courſe; fevers of the worſt kinds may be occaſioned, where nature has not the ſtrength to throw off her burden in an inflammatory erruption, as we ſometimes ſee it, upon the ſurface of the ſkin, whoſe glands are often obſtructed inflated and elevated into troubleſome and offenſive puſtules, upon the ill-adviſed or untimely uſe of the baths.

§ 319. Formerly, the patients were ordered to tarry an hour or two, in the hotter, three or four in the more temperate baths; and this in the morning onely, every day, or once in two or three days; ſpending their time walking, or ſitting and chatting, till they were diſpoſed to ſweat. This is certainly too long for any perſon to ſtay in any bath; where it is generally improper to move the limbs or exerciſe the lungs, more than neceſſity requires; and the rule of ſtaying in, till perſons are diſpoſed, or begin, to ſweat, is among the moſt indeterminate, if not abſurd, that has ever been offered. For, who can diſcover ſweat in a bath, or ſtand in warm water, or within the reach of it's ſteam, without ſeeming to ſweat?

§ 320.

§ 320. The rules before layed down, under the heads of bathing in ſimple water, and in the baths of Aken, may ſerve for theſe, when we ſee them reſcued from the ſhameful gothic ſtate in which they ſtand at preſent; crowded with both ſexes promiſcuouſly; ſo that the moſt reſpectable, as well as tender, ſuffer the inconveniences attending all crowded places; not being able, however abſolutely neceſſary, to get into, or out of the bath, within many minutes of the time deſired; that of being expoſed to the public view of the profane vulgar; to the extremes of heat and cold of the different ſeaſons of the year, and without any conveniencies for undreſſing, dreſſing, or lodging, contiguous to the baths. For mine own part, I ſhall be hard ſet, if I preſcribe them to delicate patients, before I ſee them reduced to ſome decent and regular form, where their heat and every circumſtance can be determined and adjuſted, to the ſafety and welfare of the patient, and the ſatisfaction and honor of the phyſician. If ever I find myſelf obliged to recommend them, before the wiſhed-for reformation be brought about; I am ſure, I ſhall feel no leſs horrors, than every humane phyſician now does, when he preſcribes a medicine of energy, and knows not into what apothecary's journeyman, apprentice, or ſervant's hands it may fall, in the abſence of the maſter, who generally is otherwiſe engaged, quite out of the way of his juſt profeſſion; whileſt the patient's health and life, and the preſcriber's reputation are at ſtake.

§ 321. From partial bathing and pumping particular parts with this water, effects ſimilar and proportionable to thoſe of the general bathing are to be expected; as before explaned under the heads of ſimple and medicated warm bathing. I earneſtly recommend the pump with the globe,[a] by the force of whoſe included air, the water, by the means of a flexible tube, may be thrown, with any velocity, and in any direction, upon any part required.

[a] See the Harwich baths.

§ 322.

§ 322. And if the ſteam of this water was raiſed, by little breaks or falls made in it's courſe, collected and conveyed into a proper ſudatory, as at Aken or Borſet, we might expect no leſs benefit from it, than from the later of theſe; effects ſo powerful, as have never yet been known at Bath, which every good man muſt undoubtedly wiſh, and would rejoice, to ſee.

§ 323. I can not conclude, without exhorting the Great Phyſicians of the State, the Guardians and Truſtees of the Health and Privileges of the Public, to caſt an eye upon theſe abuſed baths, and upon the city, which may be looked upon as the great Hoſpital of our dominions; and, by the interpoſition of their Authority, Public Beneficence and Wiſdom, to reform the ſhameful abuſes of theſe moſt excellent waters: Firſt, in contriving ſome fit places for the water drinkers to walk in under cover, and in convenient warmth, and for the ſexes occaſionally to retire to, during the water drinking hours. Secondly, to provide means to prevent the preſent ſhameful, indecent, and irrational promiſcuous bathing of ſexes, expoſed to the extreme viciſſitudes of the air, and to the rude eyes of the multitude, and in water, ſpoiled of much of it's medicinal virtues, by it's open expoſure; by incloſing the ſources in fit reſervoirs, and conveying the water in the utmoſt perfection into baths of different forms and ſizes, in fit houſes, furniſhed with warm ſtoves, and attiring rooms, beds, and all due requiſites for warm baths; that theſe moſt powerful remedies may be adminiſtred with the fulleſt aſſurances of ſucceſs, from having the water in perfection, and of a determined temperature, and by ſecuring the patient from all evil in going to, and returning from, the bath; which can by no means be done under the preſent abominable miſmanagement. Thirdly, in erecting Vapor Baths in ſome of the bathing houſes, where that moſt potent and grateful remedy, now unknown at Bath, may be adminiſtred with ſafety and ſucceſs. Fourthly, to diſcountenance the ridiculous cuſtom of paying obſervance to ſeaſons; ſince theſe waters,

waters, under ſuch regulations as I propoſe, may be uſed with deſirable ſafety and ſucceſs, in all ſeaſons of the year; and ſince, if regard be had to ſeaſons, the reverſe of thoſe, now attended to, thoſe of the antients, from April to July, and from the later end of Auguſt to the later end of October, muſt be the beſt; as may appear by the beggars' meeting with certain cures in thoſe ſeaſons; whileſt the opulent are denied theſe benefits, by being permitted to uſe the baths, when their uſe muſt be attended with more danger and leſs ſucceſs, in the colder months of the year onely. In fact, ſuch is the temperature of our climate, that we may uſe our warm baths, properly attemperated, in all the ordinary extremes of weather; but, they muſt be found leſs dangerous in the adminiſtring, as well as more efficacious, during the ſummer. And laſtly, with the hot, to provide proper cold baths; where, upon all emergencies, particularly after a courſe of hot bathing, the patients may ſtrengthen themſelves againſt the external cold, by frequent immerſions in proper cool or cold baths, before they ſet out upon their return to their reſpective homes. Thus may our Great Guardians improve upon the bleſſings, beſtowed upon us by provident nature, in theſe unparalleled baths; and fulfil one of the important ends of the ſacred inſtitution of PARLEMENTS, providing for the Natural as well as Political Health of the Commonwealth committed to their care.

The End of the ESSAY on BATH WATERS.

Of

Of the BATHS, *or* HOT-WELL WATERS, *near* BRISTOL.

In pure Reſpect
To Humanity, Politeneſs, and Public Spirit,
To the Name and Family
Of the firſt of Philoſophers and the beſt of Men,
Our IMMORTAL BOYLE,
And
In grateful Acknowledgement of particular Obligations,
Humbly Inſcribed
To
The Right Honorable,
The LORD DUNGARVAN.

§ 1. BRISTOL, the ſecond city in Britain, in point of trade and opulence; in which it outdoes moſt, and is inferior to few, if to any, in Europe; lyes 115 miles to the weſt of London, upon the adjoining confines of the counties of Somerſet and Gloceſter, but a city and county in itſelf. It is ſituate in one of the moſt beautiful, fertile, hilly countries in the world, well wooded, and abundantly furniſhed with excellent foſſil coal, and well watered with ſprings and rivulets of excellent water. It is waſhed by the Avon, which becomes ſomewhat more conſiderable in ſize, and ſtill more muddy near this town, than at Bath. It runs in a very deep, though narrow channel; into which, the tide flows with extreme force and rapidity, to the highth of thirty feet and upwards. This can not fail of rendering it navigable to ſhips of the greateſt burden, that belong to this celebrated

brated mart, or thoſe of other nations, that frequent her port.

§ 2. The Avon, like all rivers in hilly countries, runs every where, a winding, ſerpentine courſe; but in no place more than below Briſtol. For, after it paſſes through the flat, fertile meads and lawns, about a mile below the town; it runs through unequal precipices of wild, rugged rocks; whoſe faces in moſt places lye bare, either by nature or ſtripped by laborers, who take them aſunder for the various materials, they afford for building, &c.

§ 3. Theſe rocks are moſtly compoſed of a kind of ſolid, blew marble, which yields ſomething of a ſulphureous ſmell upon friction. The ſtones are immenſly large; in ſome places much vened with white, and in other with a dark, muddy, lute colored ſpar. Some quarries are moſt extremely and beautifully diverſified with colors and figures. The ſoil immediately about them, and the earth in, and oozings from, the fiſſures of the rocks in general, almoſt every where, and even cavities in the center of ſome of the moſt ſolid rocks, give indications of a red bolar, or martial earth.

§ 4. In chaſms and hollows of theſe rocks, where this martial earth is obſerved moſt abundant, various concretions of cryſtal are found; ſome colorleſs, and ſo hard and brilliant, as to obtain the name of Briſtol Diamonds; others, tinged of fleſh-color, yellowiſh, blewiſh, purple, and of various other tints; but, theſe are ſeldom found clear or large enough to be of any value to any, but to naturaliſts.

§ 5. On the tops of the higheſt of theſe hills, variety of ſhell fiſhes, now unknown on our coaſts, Nautilli, Cornua Ammonis, &c. as well as Corals, Coralloides, Madripores, and the like, are found in plenty, petrified.— Whether the products of the Moſaic or ſome other deluge, or the elevation of hills from the bottom of the ſea, by the means of earthquakes, or other convulſions or revolutions in the oeconomy of

this

this great globe; or from what cauſes, and of what kinds, let philoſophers and divines, of deeper penetration and more leiſure, determine.

§ 6. How the Avon found a paſſage through theſe high hills of ſolid rocks, is not leſs hard to be conceived. But, thus it runs it's rapid courſe, and diſembogues it ſelf into that great arm of the ſea, called the Briſtol Channel, or Severn Sea; which it renders of a foul muddy color for many leagues.

§ 7. At about a mile diſtant from the town, not far from the entrance of the river between theſe rocks, on the north eaſt ſide of it, and at the foot of that part of one of theſe rocky cliffs, where a chappel, conſecrated to one of the many legendary ſaints, in times of ignorance and ſuperſtition, impoſed upon our iſle; formerly ſtood, and gave the cliff the denomination of Saint Vincent's rock; riſes the ſpring, by ſome called from this rock; by others, from the neighbouring city; by others, ſimply, the Hot-wells; by others, the Old Hot-wells, in diſtinction from another of inferior note, that has been lately diſcovered, about a mile lower, on the ſame ſide of the river.

§ 8. This ſpring riſes in the channel of the river, within fiveteen or ſixteen feet of the low water mark; conſequently, within reach of the tides. Hence, it is ſubject to be overflowed and adulterated by the tides, in ſpight to all the means hitherto uſed to prevent it: In ſo much, that in dry weather, when the ſource of the ſpring is diminiſhed, if there be a great demand for the water, and the ſpring be much exhauſted, ſo that there is not enough in the well to riſe and counterbalance the tide, this laſt will ruſh in and foul the ſpring, ſo as to render it unfit for uſe; till, after the ebb, the cold water be pumped out, and the bath water be found of it's natural brightneſs and warmth.

§ 9. As I can not find any thing certain, with regard to the hiſtory of this ſpring, I ſhall paſs this part over in ſilence, and come to that, which more immediately concerns the phyſician or naturaliſt.

§ 10. The ſoil is for the moſt part moſt fruitful, the hills and fields moſt verdant, all the year round, about the Hot-wells. The tops of the hills, called Downs, are generally upon the flat, and are, in ſome places in the neighbourhood, rocky, in ſome furzy, heathy, or ferny. Milk of cows, goats, and aſſes is to be had here in the higheſt perfection, as are indeed all the neceſſaries of life, whether foregne or indigenous.

§ 11. Though the ſoil be generally dry, the air is rather to be looked upon as moiſt; as the hills are often cloud capped, and much rain generally falls there. Beſides, the dews begin early to fall in the ſhades, made by the lofty hills. But, upon the whole, it may be deemed generally healthful and agreeable to the tendereſt lungs: for, there are not obſerved, in or about it, any unwholeſom vapors or exhalations from any part of the creation.

§ 12. Patients may be lodged commodiouſly or magnificently here and in any air, that is found moſt convenient. Beſides the city, there are lodgings more contiguous to the wells, upon a hill, or on the eaſt, ſouth, or weſt ſide of it. And here are all the means of agreeable amuſements in the ſeaſons.

§ 13. The water of the river is not here fit for any purpoſes of life. It is ſo foul, that very few fiſhes, beſides ſome bad eel, choſe to inhabit it. And the exhalations from it, when the tide is out, are all that may annoy the air about the Hot-wells. And even theſe are rarely if ever complained of.

§ 14. But, there is no ſcarcity of good ſpring water; for, beſides the Hot-wells, one of the moſt remarkable, the moſt excellent of cold ſprings, any where known, riſes overagainſt the Old Hot-well, on the oppoſite ſide of the river, but not quite ſo low, of courſe, not ſo ſubject to the tide.

§ 15. This ſpring riſes in quantity large enough to turn a ſmall mill for grinding colors. And ſupplies many ſea faring men with the beſt water. It might furniſh all the ſhips of Briſtol. And, in this inſtance,

it

it will be found to make more than amends for the badneſs of the river water.

§ 16. I found this ſpring demand mine attention ſo much, at the firſt ſight of it, that I gave it a very full examination. And, as I know not it's equal in Britain; I think it of importance enough to be made known, as I am perſuaded it muſt ſerve many excellent, medicinal purpoſes, as well as the onely one to which it is now applied, that of a cold bath, in which it is no where, that I know, outdone, or even equalled.

§ 17. This great fountane is remarkably bright and pellucid, moſt perfectly inodorous, and moſt gratefully taſteleſs.

§ 18. Taken up in a glaſs, it inſtantly ſparkles nearly equal to the Pouhon at Spa, and like that, covers the glaſs with bright air bubbles. Yet, amits not in the leſt of it's pellucidity, upon many hours ſtanding in the open air. And in bottles, for upwards of two years, ſuffers no ſenſible change, but ſome loſs of this ſubtil, elaſtic air.

§ 19. In temperature, by the ſame thermometer uſed at Bath, I found it, compared to the atmoſphere, as 61, 61¼, to 70, 75.

§ 20. Upon the ballance, in the phial, in which the Bath waters were proved, it weighed ounces 4. 6. 0. 14. that is, one grane lighter than deſtilled water, two degrees leſs cold, and leſs than ſo much of either of the Hot wells, whoſe waters weigh the ſame with deſtilled water, cooled to the degree of 74.

§ 21. Hitherto, nothing has been determined with any certainty, that I can learn, concerning the component parts of Briſttol water: ſome have charged it with iron, nitre, alum, alcali, ſea-ſalt, and lime; and ſome deny moſt, and others all, of theſe to be the compoſition; aſſerting it to be the ſofteſt, ſimpleſt water known. Let ſuch nameleſs authors reſt in peace: let us come to facts.

§ 22. As there have been theſe great and irreconcileable diverſities of opinion about the nature of the

Briſtol

Briſtol Hot-well water, ſome deeming them as complicate, as others have judged them ſimple and nearly elementary; and as ſome controverſies have aroſe about the nature, and with reſpect to the affinity of the New well to the Old; I ſhall endeavor to compoſe and ſolve theſe doubts, by giving a comparative, analytical view of the ſeveral principal waters of Briſtol; taking in, with the two Hot wells, the Cold bath, or Mill ſpring, Rain water, as it is delivered from the clouds, about the Hot-wells, and the ſame deſtilled.

§ 23. As to their ſources, theſe three ſprings nearly agree:

1. The Old Hot-well at Briſtol, ſprings from the ſide of a rocky cliff; but it's ſource is not now viſible; being covered by a building to keep off the weather, and, as much as poſſible, the tides; which, in dry weather and high tides, eſpecially the ſprings, always affect it. It is raiſed by a pump; though when the tide is out, another ſpring of the ſame water appears between this and the river.

2. The New Hot-well ſprings in much alike ſituation; but, above the reach of the tides. And is raiſed by a pump alſo.

3. The Mill-ſpring riſes from a ſimilar ſoil, on the other ſide of the river; but, out of the power of the tides in general, partly from it's ſituation, but chiefly from the ſtrength of the ſtream.

§ 24. In aſpect, all the five correſpond;

1. The firſt, upon pumping a glaſs, appears perfectly colorleſs and pellucid; ſparkles, ſo as to ſeem, to ſuperficial examiners, milky; and, being ſet to ſtand, covers the inſide of the glaſs with ſmall air bubbles, which remane there, for ſeveral days, without the water's throwing up any pellicule, or letting any viſible matter ſubſide; though it amits of it's pellucidity. Kept cloſe co ked, it ſeems to ſuffer no loſs, but the cauſe of it's ſparkling, for any length of time known.

2. The ſecond agrees in appearance; but neither ſparkles ſo ſoon, or near ſo much, nor diſcharges near

ſo many air bubbles upon ſtanding. It keeps in bottles like the firſt.

3. The third appears to outdo each of the preceding in brightneſs and limpidity, as it greatly does in ſparkling more quickly and greatly, and diſcharging and depoſiting a much larger quantity of the brighteſt air bubbles in the glaſs. It ſeems to keep as unaltered as either.

4. The rain water is exceding bright and fine, not ſenſibly differing from the preceding, nor perceptibly exceded by,

5. The deſtilled rain water, in theſe reſpects.

§ 25. All are alike inodorous, except 5, the deſtilled, which ſuffers ſome ſlight change from the fire; and when equally cold, ſo much alike inſipid, as not to be eaſily diſtinguiſhed the one from the other. Theſe alſo keep long unaltered in clean bottles well corked.

1. But, the Hot-well is of ſuch a temperature, as to imprint the moſt ſoft and grateful ſenſation upon the palate; ſo that there is no liquor, of which a man may drink ſo large a draught, with ſo much eaſe and pleaſure.

2. The ſecond, though much inferior, comes nearеſt to this.

§ 26. As to temperature,

1. The firſt has not been found in the various extremes of the atmoſphere, from the later end of June, to the beginning of Auguſt, 1744; to vary one degree of the thermometer; upon the accurate trials of a truly noble man, who does honor to his high rank, as well as to the ſciences and arts, which he greatly protects, cheriſhes and enlightens: By the thermometer, which this illuſtrious peer uſed, the water was found at $24\frac{1}{4}$, $24\frac{1}{3}$, $24\frac{3}{4}$, $24\frac{5}{8}$, $24\frac{7}{8}$, or one or other of them, every day. Yet, theſe variations might not have been in the actual heat of the ſpring; but, might have aroſe from various accidents; ſuch as being more or leſs pumped, or the like. His Lordſhip's thermometer was ſo graduated, that $24\frac{7}{8}$ of his ſcale was equal to $76\frac{1}{2}$ of

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FAHRENHEIT's. Had I received this account from the right honorable philoſopher, it might have contented me, however ambitious I may be to be juſtly comprehended within the letter of the motto to the arms of our Royal Society, where his Lordſhip preſides; Nullius in verba. But, I did not; and beſides, I judged it neceſſary to compare the heat of theſe baths to thoſe of Bath. I therefore, examined them by the ſame thermometer, in the months of June and July in the year 1753. And by this, conſtantly found,

1. The firſt, at low tides, and after long pumping, when the atmoſphere varied from 68 to 75, between 83 and 84.

2. The ſecond, at the ſame time, never roſe above $71\frac{1}{4}$.

3. The third, in the cold bath, ſunk the mercury, at the ſame time, to 62, 63. In the ſpring, it hardly varied from $61\frac{1}{4}$.

4, 5. The temperature of theſe muſt depend upon that of the veſſels and air, in which they ſtand.

§ 27. By the balance, in the ſame phial with the Bath waters;

1. The firſt of the natural heat, weighed
ounces 4. 6. 0. 15.
Cooled to 70, by lying open, - - 4. 6. 0. 16.
2. The ſecond, of the natural heat 4. 6. 0. 16.
Cooled to 70, by lying open, - - 4. 6. 0. $16\frac{1}{4}$.
3. The third, of the natural coldneſs, 4. 6. 0. 14.
4. The fourth, of that of the air at 70, 4. 6. 0. $15\frac{1}{2}$.
5. The fiveth, of the ſame, - - - 4. 6. 0. 15.

§ 28. With the ſirup of violets, fourty drops to two ounces of the water;

1. In the firſt, it ſtrikes a ſea green, on mixture, which gradually highthens for ſome hours, before it comes to a graſs green. After eighteen hours, the color appears ſaddened with a yellowiſh caſt. The water, after lying open ſome hours, produces theſe changes more ſuddenly.

2. In the ſecond, the ſame effects are nearly produced.

3. In the third, it is onely diluted at firſt; but, in about a minute, it puts on a pale, ſea green hue. Within two hours, it improves to a pale graſs green; and hardly changes further, in twenty four.

4. In the fourth, it mixes, with hardly any change, but dilution of color, and continues ſo ſeveral hours.

5. In the fiveth, it is ſtill further from change of color.

§ 29. With the infuſion of galls, to ten drops;

1. In the firſt, it cauſes no change of color, upon mixture. Upon ſtanding, it grows milky, firſt at the ſurface, throwing up a pale, pearl colored pellicule, which gradually changes to the diverſicolored. It contracts a milkineſs all over, and turns to a pale green, firſt at the ſurface. Under the pellicule, much air is lodged, in frothy bubbles.

2. In the ſecond, no change of color; but it becomes more and ſooner milky; throws up the like pellicule; but none air.

3. In the third, no change of color; grows ſlowly and ſlightly milky; throws up the like pellicule, with moſt air, and turns the deepeſt green.

4. In the fourth, it gives no change at firſt; but, by degrees, grows palely milky, and in about twelve hours, ſhews ſome ſhades of a yellowiſh green.

5. In the fiveth, no change is perceptible for ſome hours; then, it grows milky, and continues ſo, without changing color any further.

§ 30. With the infuſion of Campechy log-wood, to twelve drops;

1. In the firſt, it ſtrikes between a pale roſe, and a deep Madeira color. In two hours, much deeper. In twenty four, a deep amber color. A pale, variegated pellicule, air bubbles and froth.

2. In the ſecond, ſomewhat more upon the purple, improves and ends as the firſt, ſomewhat paler; without air bubbles or froth.

3. In the third, a bright crimſon; improves and ends like the reſt; but leaves more air bubbles and froth.

4. In

4. In the fourth, an high Madeira color, which highthens for a while, and then, ends in a pale Canary color.

5. In the fiveth, a Canary color of the paleſt; which deepens for a while, to ſome ſhades of crimſon; but ſoon after, returns to the firſt color.

§ 31. With the infuſion of rhubarb, to ſeven drops;

1. In the firſt, it produces a pale, lemon color, which grows gradually deeper, till in about twenty four hours, it becomes an orange, or bright, amber color; throwing up a ſlight, pale pellicule, with ſome froth.

2. In the ſecond, much the like appearances; but no froth.

3. In the third, much the like effects; but with much frothy air bubbles.

4. In the fourth, a pale, lemon color, which gradually highthens to ſome degree of orange.

5. In the fiveth, a pale, lemon color, without further change.

§ 32. With the infuſion of cochinelle, to ſix drops;

1. In the firſt, it gives a pale roſe purple; which, in a few minutes, begins to fade. In ſome hours, the color ſeems quite diſcharged; while numbers of ſmall clouds, of a green caſt, appear partly ſuſpended, but moſtly precipitated.

2. In the ſecond, the like changes appear, with ſome ſeeming milkineſs in the liquor.

3. In the third, the ſame appearanees, as in the 2. rather paler and lighter.

4. In the fourth, a fair, bright crimſon, which deepens gradually for ſome hours; and in about twelve, appears upon the decline.

5. In the fiveth, there appears but a dilution of color, which highthens in the red, but not in the purple hue; ſo as, in twelve hours, to appear of the ſcarlet dye.

§ 33. With the volatile alcalies;

1. In the firſt, the ſpirit of ſalt ammoniac, with a

fixed alcali, twelve drops, ſenſibly increaſed the ſparkling of the water, if it did not cauſe an actual ebullition; no milkineſs; in twenty four hours, a very ſlight, pale pellicule and precipitate; none air.—The volatile ſalt, four granes, cauſed a quick, ſmart ebullition, ſo as to make all the liquor appear white, with ſmall, frothy bubbles; no milkineſs. Upon ſtanding, there appeared a very ſlight precipitation and pellicule.

2. In the ſecond, the like effects, in an inferior degree in all reſpects, by the liquid and concrete alcali.

3. In the third, the like by both, the ebullition by much the ſmarteſt and ſtrongeſt, the precipitate ſtill the ſlighteſt.

4. In the fourth, the liquid cauſed no ſenſible change. The concrete, at firſt none; but, upon ſtanding, a very ſubtil precipitate, in a very ſmall quantity.

5. In the fiveth, neither works any ſenſible change.

§ 34. With fixed alcaline ſalts;

1. In the firſt, the alcaline ley, ſix drops, produced a milkineſs at every drop, with ſome ſlight appearance of ebullition. Viewed in twelve hours, a pale, white pellicule appeared at the ſurface, and a large, groſs, palpable precipitate at bottom; many air bubbles, as from the conſequence of a ſlow ebullition in the glaſs. —The alcali concrete, with a ſenſible, ſtrong ebullition; produced all the other effects.

2. In the ſecond, effects nearly ſimilar are produced, with the liquid and concrete alcali; but all in a leſſer degree.

3. In the third, at dropping, no change; in ſome time after, a very ſlight milkineſs; none ebullition. Upon ſtanding, this milkineſs ſubſides, ſlightly coating the glaſs, with a very inconſiderable, white precipitate; without ſhewing any pellicule, or any air.—With a quick and ſtrong ebullition, the concrete alcali produces the like effects.

4. In the fourth, the liquid alcali cauſed no change; but, four granes of the dry alcali gave a ſlight milkineſs and precipitate, inferior to 3.

5. In the fiveth, neither the liquid nor the concrete wrought any ſenſible change.

§ 35. The ſolution of ſope, twelve drops;

1. In the firſt, becomes milky to opacity, and grumous at mixture; ſoon after which, it is coagulated and decompoſed.—Some air bubbles in the glaſs, after twenty four hours.

2. In the ſecond, the like changes are wrought. None air bubbles at any time appear.

3. In the third, a very ſlight milkineſs, or a pale, pearl color, without any coagulation or ſeparation, for above twenty four hours. Some air retained ſo long.

4. In the fourth, a ſlighter milkineſs, and no ſeparation.

5. In the fiveth, the ſlighteſt milkineſs onely.

§ 36. All the acids, vegetable, as well as mineral;

1. In the firſt, cauſe a ſmaller or greater increaſe of ſparkling, having the appearance of an ebullition, plane and evident.

2. In the ſecond, the like, but much inferior; ſo as to appear but doubtful, with the weaker acids.

3. In the third, theſe appearances, more ſtrong and evident than in the firſt.

4. In the fourth, no ſenſible change.

5. In the fiveth, none alſo.

37. With all ſorts of new milk;

The 1. 2. and 3. mix, in all degrees of heat, and in all proportions, without any more change than is cauſed by 4, 5; which is univerſally known to be none.

§ 38. With the ſolution of corroſive ſublimate, to twelve drops;

1. In the firſt, ſome ſlight increaſe of ſparkling is produced, but no milkineſs, yellowneſs, or other change of color. In about an hour, a pale, mother of pearl colored pellicule ariſes, and by degrees becomes variegated with all the colors, and afterwards, more groſs and obſcure; while the mixture preſerves it's pellucidity, after twenty four hours ſtanding; when many air bubbles remane in the glaſs.

2. In the ſecond, much the like appearances enſue; with much leſs increaſe of ſparkling, and leſs air remaning after ſtanding.

3. In the third, the greateſt increaſe of ſparkling, and moſt air remaning after ſtanding; the other appearances not ſenſibly different.

4. In the fourth, no change at mixture; but, upon ſtanding, the like pellicule with the reſt, and a very ſlight milkineſs aroſe.

5. In the fiveth, the leſt appearances of change in any.

§ 39. With the ſolution of mercury, in the acid of nitre, ſix drops;

1. In the firſt, every drop cauſes a milky cloud, which grows quickly opac, and puts on a pale yellow. In about two hours, a grumous precipitate, of a turpeth mineral color, is formed. In twenty four hours, the precipitation is perfected; no pellicule; ſome air.

2. In the ſecond, the like circumſtances attend; the clouds of a milky yellow; the precipitate more grumous, of a more obſcure color, inclining to the goſling green.

3. In the third, every drop cauſes a pearl color, of a yellowiſh hue. In two hours, no viſible precipitation. In twenty four, the liquor turbid, of a muddy amber color, with a moſt light, ſlight precipitate at bottom; ſome air bubbles.

4. In the fourth, it cauſes no change at mixture; but, upon ſtanding, throws up much the like pellicule as is produced by the corroſive ſublimate; and ſhews ſome white, light clouds ſupended in the liquor.

5. In the fiveth, no ſenſible change in ſeveral hours.

§ 40. With the ſolution of lead, in deſtilled vinegar;

1. In the firſt, every drop cauſes milky clouds, which ſoon put on a pearl opacity, and then ſuddenly ſubſide, in bright, white grumes, to the bottom; leaving the liquor bright, with ſome air bubbles.

2. In

2. In the ſecond, the like appearances are produced.

3. In the third, the like, leſs precipitate, but rather more perfect, with moſt air.

4. In the fourth, no ſenſible change, till after ſome hours ſtanding, and then but a very ſlight degree of milkineſs.

5. In the fiveth, hardly any perceptible change; at leſt, by far the leſt of any.

§ 41. With the ſolution of ſilver, four drops;

1. In the firſt, milky clouds are cauſed at every drop, which ſoon grow opac, and the whole mixture, in about an hour, puts on a milky, tinged with a purple, hue, with ſome apparent precipitation of a deeper color. In twenty four hours, it appears perfectly precipitated of a darker purple, more upon the blew; and retains ſome air bubbles.

2. In the ſecond, the like effects; the precipitate ſooneſt formed, and deepeſt colored; leſs air remaning.

3. In the third, the like appearances enſued, the precipitate the paleſt and lateſt formed; retaining the moſt air.

4. In the fourth, at firſt, a very ſlight milkineſs; which, upon ſtanding, was attended with a bright, light brown or purpliſh precipitate.

5. In the fiveth, hardly any perceptible change.

§ 42. Set over the fire, in any thin veſſel;

1. The firſt preſently covers the bottom and ſides thickly with minute air bubbles. Theſe ſoon increaſe, in number and ſize, as the liquor heats; and then, riſe with rapidity to the ſurface; ſo as to put on the appearance of boiling water, before it be thoroughly heated. By the time it boils, it loſes of it's pellucidity, and depoſites a pale, terrene, chalk like matter, looſely upon the bottom and ſides of the veſſels. — In this manner, all the tea-kettles about the Hot-wells, in which the bath water has been often boiled, are coated, thickly, but looſely with this matter.

2. The

2. The ſecond ſhews not near ſo much air, and is not ſo ſoon put in motion; but yet, coats the veſſel, in which it is boiled, in much the ſame manner.

3. The third ſhews moſt air, and is moſt readily put in motion by heat, and the air bubbles riſe above the ſurface of the water, with a ſparkling noiſe. After boiling, it amits of it's pellucidity; but, neither ſenſibly coats the veſſel, nor depoſites any viſible ſediment.

§ 43. By this means, each water is decompoſed, ſpoiled of it's mineral ſpirit; on which, I reſt it's chief energy; and the firſt and ſecond, which before, were too hard for diſſolving ſope, or ſerving the ordinary purpoſes, now become as ſoft as rain water. Which intimates what is loſſed in this operation; a volatile, mineral acid.

§ 44. A gallon deſtilled, in an high bolled retort, in ſand, placing a piece of blew paper in the juncture, and luting it carefully;

1. The firſt gave the appearances mentioned, § 42. 1. ſhewed no ſtriae or venes, but a dewy moiſture in deſtilling. When about two ounces were deſtilled, the junctures were opened, and the deſtilled liquor examined. In ſenſible qualities, weight, or upon mixture, with ſirup of violets, ſolution of ſublimate, lead, or ſilver, it ſhewed not any thing remarkably different from rain water in the like manner deſtilled. Yet, the blew paper was ſlightly faded to a purpliſh.

2. The ſecond gave the like products more faintly in all reſpects.

3. The third deſtilled moſt quickly, with the like appearances; the deſtilled liquor, upon mixture with the ſolution of ſilver, became a little milky; and the color of the paper was faded to a tinge, ſtill deeper upon the purple.

§ 45. Being ſlowly evaporated to a dryneſs in a flat glaſs in a ſand heat;

1. The firſt, out of twenty ſeven pints, wine meaſure, yields one hundred and twenty five granes of a ſubſtance, compoſed of terrene pellicules, the one ſucceding

ceding the other, as in the Bath waters, and of much the ſame color, rather paler, of a terrene, ſaltiſh taſte, with ſome bitterneſs. This proportion gives but four granes and about ſix eighths to the pint. Upon another trial, I obtained five granes from the pint.

2. The ſecond gives about four granes and an half, ſometimes near five granes, of the ſame kind of matter, in ſenſible qualities, like the firſt.

3. The third, diſcharging air bubbles to the laſt, and ſhewing no change of color or pellicule, yields, of a pure, perfectly white matter, five granes to the pint.

4. The fourth, with little appearance of air, left an earthy ſubſtance, ſlightly colored with the oily matter, to about three granes to the pint.

5. The fiveth, with like appearances, left the glaſs thinly coated with a bright, white matter; not exceding half a grane to the pint.

§ 46. The remanes after evaporation, like thoſe of the preceding waters, waſhed with deſtilled water;

1. Fivety granes, the remanes of ten pints of the firſt, left, of terrene matter, of a pale, milky white, twenty ſix granes and a quarter.

a. This earth, by calcination, gave lime; whence, it has been generally conſidered merely as a calcarious earth. But, that it is not purely ſuch, appears by the following experiments.

b. It cauſes an ebullition upon mixture with all the acids; which has been deemed a confirmation of the preceding notion. But,

c. It does not entirely diſſolve in any acid; nor, above two granes and three quarters in five, of it, in the acid of ſalt; the remaning, two granes and one quarter, being fair and diſtinct, inſoluble ſelenite.

2. The ſecond, in the ſame quantity, left about twenty five granes of an earth in all reſpects ſimilar; but the proportion of the ſelenite ſomewhat greater.

3. The ſame quantity of the third left fiveteen granes of a pure white earth, about three fiveths of which,

upon

upon the preceding trial, appears to be calcarious, the reſt ſelenite.

§ 47. The waſhings of each evaporated to a dryneſs, in flat, flint veſſels, by a ſlow heat, in a ſand furnace;

1. The firſt gave, firſt, cryſtals reſembling Glauber's ſalt, and then, ſhewed ſome cubical cryſtals of muriatic ſalt. Being urged to a dryneſs, the whole maſs weighed twenty three granes and three quarters. This expoſed about twelve hours to the open air, increaſed four granes in weight.

a. This maſs rediſſolved in deſtilled water, the ſolution cauſes no change in ſirup of violets, nor any commotion with acids. Which ſhews, it contains nothing alcaline.

b. This ſolution is rendered turbid, and precipitates a white earthy matter, with fixed alcalies; which is the baſis of the Glauber and ſea ſalts; and of the bittern, which cauſed the increaſing of weight in N° 1.

c. Theſe, as well as they may be, ſeparated by cryſtalliſation, appear upon every trial to conſiſt of theſe two ſalts, in nearly the ſame proportions as in Bath water, § 249. each ſalt ſtanding the like teſts.

2. The ſecond yields the like ſalts and bittern, but a leſs proportion of that of Glauber.

3. The third, the ſame, but ſtill leſs of Glauber's ſalt, and more of the bittern than either.

§ 48. The dry maſs of ſalts of each, gives a ſubtil, inviſible, pungent exhalation, upon the addition of the ſtrong acid of vitriol; probably, a portion of the volatile, mineral ſpirit, adherent to the alcaline baſe; and diſtinct from this, the ſharp, white fumes of the acid of ſalt.

§ 49. There is none appearance of the yellow or rediſh fumes, nor the ſmell, that nitre gives upon this mixture. Nor does the maſs of ſalts, nor either of them apart, fulgurate, flagrate or ſparkle, thrown upon lighted coals. This ſhews the miſtake of thoſe, who aſcribe nitre to theſe waters.

§ 50. This

§ 50. This is further proved, by their fuſing ſmoothly and uniformly, without riſing into tenacious bubbles like alum; which proves them void of that concrete. Moreover, if while in fuſion, a ſmall quantity of powdered charcoal be added, inſtead of fulgurating, as nitre does with ſuch a mixture, they unite, imbibe the inflammable principle from the coal, and give a liver of ſulphur; whence, upon ſolution and the addition of any acid, ſulphur, in the form of a magiſtery, may be precipitated. Which proves the priſmatic, cryſtalline ſalt, a vitriolate ſalt, of the nature of that of Epſom, and ſuch like ſprings.

§ 51. Upon comparing theſe experiments with thoſe upon the other waters, where the cauſes of the ſeveral changes are explaned, the nature and quality of theſe waters muſt as planely appear, as the extravagance of thoſe analyſers, who deem the firſt but a ſimple, elementary fluid; as well as that of ſuch as charge it with, what nature never did, iron, nitre, alum, lime, vitriol, ſulphur, &c.

§ 52. Among theſe diſcordancies, the favorite opinion ſeems to lean towards the lime: For, ſome are abſurd enough to look upon it as a natural lime water; or, water deriving it's heat and qualities from foſſil lime.

§ 53. If lime could ever have been diſcovered in the bowels of the earth, the heating and impregnating of water might be eaſily accounted for. But this, upon the ſtricteſt reſearches, has never yet appeared, even where the moſt violent ſubterranean heat has been found.

§ 54. Subterranean lime, had ſuch a thing been ſeen, might ſhew us a ſhort method of accounting for earthquakes. I have obſerved very remarkable effects from lime incloſed in bricks, which often happens in countries, where they have not the judgement to chooſe loam, void of limeſtone pebble. If ſuch be incloſed in brick, upon burning, they muſt be reduced to lime. Such brick, kept dry, preſerve the lime and their own form

for

for ages. But, being once wet, they imbibe the moiſture and impart it to the thirſty lime; this greedily receives it, grows hot, ſwells, burſts the brick, with an exploſion, then crumbles into duſt. I have known whole houſes, quickly run up, ſuddenly fall; where no better reaſon than this could be aſſigned. The like effects might well be produced from lime made and incloſed in the bowels of the earth. But, till ſuch be found, it is but ridiculous to argue upon the matter; eſpecially, as we have ſhewn a more natural and familiar cauſe of ſubterranean fire, &c. in explaning the heat and cauſes of heat in the waters of Aken.

§ 55. But, why are thoſe waters ſingled out as calcarious, more than any other?—It is true, they contain a calcarious earth. But, it is far from being ſimply ſuch. Beſides, moſt waters have an equal, and many a ſuperior titule to the appellation of calcarious.

§ 56. A ſummary of the impregnation of theſe three, 1, 2, 3. waters, is this; firſt, the common baſe of the compoſition, ſimple water; by exhalation from decompoſing pyrites, at a certain diſtance, impregnated with ſome of the groſſer, but more of the ſubtiliſed, univerſal acid, and alſo by thoſe, heated to the degree, ſet forth. Secondly, water thus charged, meeting with an alcaline and calcarious earth, with ſome proportion of the mercurial principle, it is not difficult to conceive how the impregnation, we find, ſhould be produced. 1. The groſſer, with the volatile acid, uniting with an alcaline earth, or the mineral alcali, give the vitriolate ſalt, diſcovered in theſe waters. 2. Theſe acids, with the mercurial principle, and the alcaline baſe, conſtitute the ſea ſalt, obſerved in them. And, 3. theſe acids, meeting with, and diſſolving, abſorbent earths, muſt yield a calcarious earth and a ſelenite upon evaporation. Agreeable to this theory it is, that theſe waters appear, by our experiments, to be thus impregnated. And from theſe principles, their principal virtues are to be deduced.

§ 57. Upon

§ 57. Upon a fair examination of the caſes, in which theſe waters are found ſerviceable, their good effects can onely be aſcribed to the compoſition now demonſtrated; much to the water and it's grateful temperature; ſomewhat to the ſalts; but moſt of all to the ſubtil, mineral, acid ſpirit.

§ 58. Briſtol and Bath waters differ then, onely in the later's containing a ſmall quantity of iron; and ſome ſmall diſparity in the proportions of the oily matter, and the other ingredients, which each holds in common.

§ 59. It is then unneceſſary to prolong this tract, with a particular detail of the virtues of this water; ſince, it muſt appear, that the principal difference, between it and Bath water, ariſes from the ſmall portion of the iron, contained in the later. This then, poſſeſſes all the virtues of the Briſtol baths, in an higher degree. But, theſe may be ſafely given in ſeveral caſes, where thoſe would prove deſtructive; ſuch as a variety of pulmonic phthiſics; in which, the Hot-well water and the neighbouring air prove moſt ſalutary.

§ 60. Nature and the ſituation has pointed out the fit ſeaſons for uſing theſe waters. Such as can bear that air, may drink them, all the year round. But, the ſummer months are certainly the beſt, in general.

§ 61. In the carriage, this water, as well as that of Bath, greatly loſes it's volatile, acid ſpirit. So that, to drink either of theſe waters in perfection, recourſe muſt be had to their reſpective ſources. As the Briſtol water is leſs hard than that of Bath, it may be taken at meals, as common beverage, when this muſt be found improper. And, in the medicinal intention, the former may be taken in an advanced doſe.

§ 62. Where a water of this particular temperature may not, as in ſome delicate habits it muſt, be neceſſary; in all intentions, to be anſwered by the Hot-well water, ſuch as hectics, diabetes, &c. I ſhould prefer the ſimple, neglected Mill ſpring; for reaſons, that

muſt

must appear obvious to all, who consider the comparative analysis in the preceding experiments. In carriage, it suffers a less sensible change; because it can be corked closer, or filled fuller, than the warmth of the Bristol water will admit.

§ 63. As at Bath, it is easy to see what is to be expected from such an impregnation, of such a temperature, as the Old Hot-well. It is a most powerful, temperate bath. But, for a pure, cold bath, none excedes, and few, if any, equals, the Mill spring.

The End of the ESSAY on BRISTOL WATERS,

And of PART III.